Network Standard

NETWORK	Document No	:	NW000-S0092
	Amendment No	:	0
	Approved By	:	Chief Engineer
	Approval Date	:	28/06/2015
	Review Date	:	01/11/2016

NW000-S0092 NS220 OVERHEAD DESIGN MANUAL

ISSUE

For issue to all Ausgrid and Accredited Service Providers' staff involved with the design of overhead distribution lines, and is for reference by field, technical and engineering staff.

Ausgrid maintains a copy of this and other Network Standards together with updates and amendments on www.ausgrid.com.au.

Where this standard is issued as a controlled document replacing an earlier edition, remove and destroy the superseded document.

DISCLAIMER

As Ausgrid's standards are subject to ongoing review, the information contained in this document may be amended by Ausgrid at any time. It is possible that conflict may exist between standard documents. In this event, the most recent standard shall prevail.

This document has been developed using information available from field and other sources and is suitable for most situations encountered in Ausgrid. Particular conditions, projects or localities may require special or different practices. It is the responsibility of the local manager, supervisor, assured quality contractor and the individuals involved to make sure that a safe system of work is employed and that statutory requirements are met.

Ausgrid disclaims any and all liability to any person or persons for any procedure, process or any other thing done or not done, as a result of this Standard.

All design work, and the associated supply of materials and equipment, must be undertaken in accordance with and consideration of relevant legislative and regulatory requirements, latest revision of Ausgrid's Network Standards and specifications and Australian Standards. Designs submitted shall be declared as fit for purpose. Where the designer wishes to include a variation to a network standard or an alternative material or equipment to that currently approved the designer must obtain authorisation from the Network Standard owner before incorporating a variation to a Network Standard in a design.

External designers including those authorised as Accredited Service Providers will seek approval through the approved process as outlined in NS181 Approval of Materials and Equipment and Network Standard Variations. Seeking approval will ensure Network Standards are appropriately updated and that a consistent interpretation of the legislative framework is employed.

Notes: 1. Compliance with this Network Standard does not automatically satisfy the requirements of a Designer Safety Report. The designer must comply with the provisions of the Workplace Health and Safety Regulation 2011 (NSW - Part 6.2 Duties of designer of structure and person who commissions construction work) which requires the designer to provide a written safety report to the person who commissioned the design. This report must be provided to Ausgrid in all instances, including where the design was commissioned by or on behalf of a person who proposes to connect premises to Ausgrid's network, and will form part of the Designer Safety Report which must also be presented to Ausgrid. Further information is provided in Network Standard (NS) 212 Integrated Support Requirements for Ausgrid Network Assets.

2. Where the procedural requirements of this document conflict with contestable project procedures, the contestable project procedures shall take precedent for the whole project or part thereof which is classified as contestable. Any external contact with Ausgrid for contestable works projects is to be made via the Ausgrid officer responsible for facilitating the contestable project. The Contestable Ausgrid officer will liaise with Ausgrid internal departments and specialists as necessary to fulfil the requirements of this standard. All other technical aspects of this document which are not procedural in nature shall apply to contestable works projects.

INTERPRETATION

In the event that any user of this Standard considers that any of its provisions is uncertain, ambiguous or otherwise in need of interpretation, the user should request Ausgrid to clarify the provision. Ausgrid's interpretation shall then apply as though it was included in the Standard, and is final and binding. No correspondence will be entered into with any person disputing the meaning of the provision published in the Standard or the accuracy of Ausgrid's interpretation.

KEYPOINTS

This standard has a summary of content labelled "KEYPOINTS FOR THIS STANDARD". The inclusion or omission of items in this summary does not signify any specific importance or criticality to the items described. It is meant to simply provide the reader with a quick assessment of some of the major issues addressed by the standard. To fully appreciate the content and the requirements of the standard it must be read in its entirety.

AMENDMENTS TO THIS STANDARD

Where there are changes to this standard from the previously approved version, any previous shading is removed and the newly affected paragraphs are shaded with a grey background. Where the document changes exceed 25% of the document content, any grey background in the document is to be removed and the following words should be shown below the title block on the right hand side of the page in bold and italic, for example, Supersedes – document details (for example, "Supersedes Document Type (Category) Document No. Amendment No.").

KEY POINTS OF THIS STANDARD

Scope and Risks Addressed

This standard is limited primarily to support distribution design, it also covers the design of basic subtransmission lines. It provides design support information concerning existing and new assets. In general it covers the following risks:

- Design of new and replacement of existing assets.
- Mechanical and electrical design criteria
- Loading and rating information
- Selection and use of appropriate software
- Supports designers of Ausgrid's overhead network for Ausgrid staff and ASPs.

Where to for more information?

Section 1, 2

Design Summary and Design Process

These sections identify/summarise major design requirements that include:

- Ensuring mechanical load forces do not exceed the strength of structures
- Adequate clearances exist between elements of the network – conductors, ground, other structures, etc.
- Iterative nature of the design process.
- Design factors such as wind loading, line temperatures, structural strengths, clearances etc.
- Overview of the design process including step-by-step notes.
- Several worked examples
- Design documentation

Where to for more information?

Section 5, 6

Tools and Forms

Too many to list

Design Components

The design requirements of specific parts of a project design are outlined. These include:

- Conductors and cables
- Poles
- Stays
- Poletop constructions

Where to for more information?

Section 7 - 11

Tools and Forms

Too many to list

Reference Data

A large amount of reference material is provided to assist with design data and assessment of designs. This includes

- Mechanical loading tables
- Clearance data
- Crossings design information – for railways, waterways, roads, undercrossings, etc
- Earthing design data
- Software packages and settings

Where to for more information?

Section 12 - 17

Tools and Forms

Too many to list

Network Standard
NS220
Overhead Design Manual

Contents

1.0 PURPOSE

This manual is to be used to support the overhead line design process. Its purpose is as a standard designer's checking tool and a training aid. It is not intended to replace the use of appropriate overhead line design software, and is not to be used as a sole design tool. Ausgrid requires all overhead line designs to be undertaken using appropriate line design software. An exception may be made for emergency situations.

Good design is critical to success in terms of:

- compliance with applicable regulations and standards
- ensuring that the distribution network is developed with adequate safety and reliability
- ensuring consistency across the Ausgrid network
- cost-effectiveness
- ease of construction, maintenance and operations.

This manual has been produced to support designers of Ausgrid's overhead network, both internal staff and Accredited Service Providers (ASPs), as well as those checking and auditing design work.

It is intended to interpret high level national standards such as AS/NZS 7000/ENA C(b)1 [Reference 23] and other Ausgrid Network Standards, enabling design **checking** to be carried out quickly at a simple level, without the aid of advanced computer software. For this purpose, it provides a simple 'cookbook' approach. For example, it uses a limited range of 'standard' conductor stringing tables to facilitate tabulation of conductor sags and forces.

Excellence in engineering is encouraged. Designs prepared with the TLPRO software package or another recognized Overhead Line Design package shall generally be acceptable, subject to the correct configuration and setting of parameters. Other recognized software packages are listed in Section 15 along with details of settings to be used.

2.0 SCOPE

While the manual is primarily to support distribution design, it also covers the design of basic subtransmission lines. The Manual's tables were prepared using TL Pro software as the calculation engine.

This Manual is the standardising design checking guide for use by Overhead Line Designer Trainers, Ausgrid's Contestable Design Certifiers, Ausgrid's internal Overhead Line software designers and ASP Overhead Line software designers, all of whom are still required to utilise specific and appropriate software to undertake the line design.

This manual should be interpreted in conjunction with the as current Ausgrid Manuals Standard Constructions - Distribution, Standard Constructions - Subtransmission as well as other as current Ausgrid Network Standards listed in section 3. Where differences exist, precedence shall be granted to the more specific Ausgrid Network Standard except where appropriate written authorisation is obtained to do otherwise. (Refer to NS109)

In emergency situations only, this Manual may be used by Ausgrid's internal designers only, when software design is not practicable or timely.

3.0 REFERENCES

3.1 General

All work covered in this document shall conform to all relevant Legislation, Standards, Codes of Practice and Network Standards. Current Network Standards are available on Ausgrid's Internet site at www.ausgrid.com.au.

3.2 Ausgrid documents

- Bushfire Risk Management Plan
- Company Form (Governance) - Network Document Endorsement and Approval
- Company Procedure (Governance) - Network Document Endorsement and Approval
- Company Procedure (Network) - Production / Review of Network Standards
- Customer Installation Safety Plan
- Electrical Safety Rules
- Electricity Network Safety Management System Manual
- NEG-OH21 Vegetation Safety Clearances
- NS104 Network Project Design Plans
- NS109 Design Standards for Overhead Development
- NS116 Design Standards for Distribution Earthing
- NS122 Pole Mounted Substation Construction
- NS124 Specification for Overhead Service Connections up to 400 Amps
- NS125 Specification for Low Voltage Overhead Conductors
- NS126 Specification for Design and Construction of High Voltage Overhead Mains
- NS128 Specification for Pole Installation and Removal
- NS135 Specification for the Design and Construction of Overhead Sub-Transmission Lines
- NS143 Easements
- NS167 Positioning of Poles and Lighting Columns
- NS181 Approval of Materials and Equipment and Network Standard Variations
- NS201 All Dielectric Self Supporting Fibre Optic Cabling for the Installation of Distribution Assets
- NS212 Integrated Support Requirements for Ausgrid Network Assets
- NS214 Guide to Live Line Design Principles
- NS261 Requirement for Design Compliance Framework for Network Standards
- Ausgrid drawing 61501: Overhead Stays and Stay Poles Anchorages, Footings and Termination Arrangements.
- Supply Policy – Electrical Standards (ES Range of Documentation)
- Network Engineering Guidelines—Distribution Type Design
- Public Electrical Safety Awareness Plan
- Public Lighting Management Plan
- Tree Safety Management Plan
- Network Engineering Guidelines—Subtransmission Type Design

3.3 Other standards and documents

The following list of references is numbered to make it easier to identify specific references within the text of this network standard. The list is still in alphabetic order and be accessed either numerically or alphabetically as the need arises.

1. Alcoa Aluminium Overhead Conductor Engineering Data
2. AS1154 Insulator and Conductor Fittings for Overhead Power Lines
3. AS/NZS1170 Structural Design Actions (Wind Code)
4. AS/NZS 1170. 2 Structural Design Actions – Wind Actions
5. AS/NZS 1170. 2-2002 Wind Code

6. AS1222 Steel Conductors and Stays
7. AS 1418. 10- 2008 Elevated Work Platform Electrical Insulation
8. AS1531 Conductors – Bare Overhead – Aluminium and Aluminium Alloy
9. AS1720 Timber Structures
10. AS1746 Conductors – Bare Overhead – Hard-drawn Copper
11. AS/NZS1768 Lightning Protection
12. AS1824 Insulation Coordination
13. AS2209 Timber Poles for Overhead Lines
14. AS 3600 Concrete Poles
15. AS3607 Conductors – Bare Overhead Aluminium and Aluminium Alloy, Steel Reinforced
16. AS/NZS3675 Conductors – Covered Overhead – for Working Voltages 6. 35/11(12)kV up to and including 19/33(36)kV
17. AS/NZS3835 Earth Potential Rise – Protection of Telecommunications Network Users, Personnel and Plant
18. AS4065 Concrete Utility Service Poles
19. AS4436 Guide for the Selection of Insulators in respect of Polluted Conditions
20. AS4676 Structural Design Requirements for Utility Service Poles
21. AS4677 Steel Utility Service Poles
22. AS 5804-2010 High –voltage live working
23. Draft AS/NZS 7000, “Overhead Line Design – Part 1: Detailed Procedures” (to supersede Reference 37)
24. AS 61508 Functional safety of electrical / electronic / programmable electronic safety-related systems
25. AS /NZS ISo/IEC 90003:2007 Software Engineering –Guidelines for the application of AS/NZS ISo 9001:2000 to computer software
26. ASCE /SEI 48-05 ASCE Design of Steel Transmission Pole Structures
27. ASCE / SEI 104, 2003, Recommended Practice for Fiber-Reinforced Polymer Products for Overhead Utility Line Structures,
28. Ausgrid website www.ausgrid.com.au for current issue of Ausgrid Network’s Network Standards
29. CIGRE SCB2. 12. 3 “Sag Tension Calculation Methods for Overhead Lines” CIGRE Technical Brochure No. 324, 2007
30. CIGRE WG 22. 05 “Permanent Elongation of Conductors Predictor Equations and Evaluation Methods” CIGRE Electra No 75 1981
31. C. O. Boyse and N. G. Simpson “The problem of Conductor Sagging on Overhead Transmission Lines” Journal of the Inst. Of Elec. Eng. Vol 91 Pt II Dec 1944 pp 219 – 231.
32. EA NSW Overhead Line Construction, Standard Drawings and Design Data, Vol. 4 Drawing EAS/4/11/4
33. EC5 - Electricity Council of NSW – Guideline to Protective Earthing
34. EC 23- 1995, Guide to Working on Overhead Lines subject to Induced or Transferred Voltages
35. Electricity Authority of NSW High Voltage and Earth Return for Rural Areas
36. ENA Doc 001-2008 National Electricity Network Safety Code
37. ENA Handbook C(b)1—2006 “Guidelines for Design and Maintenance of Overhead Distribution and Transmission Lines”,
38. EP 10 01 00 05 SP – Rail Infrastructure Corporation Requirements for all Electric Aerials Crossing RIC Infrastructure
39. ESAA D(b)5 Current Rating of Bare Overhead Line Conductors
40. Gillespie,A. ,EEP 216 Overhead Line Design –Electrical, QUT
41. Gorur, RS, Cherney EA, Burnham JT, 1999, Outdoor Insulators, Phoenix, Arizona
42. HB101 (CJC5) Coordination of Power and Telecommunications – Low Frequency Induction (LFI): Code of Practice
43. Holmes JD, 2002, A Re-analysis of Recorded Extreme Wind Speeds in Region A, Australian Journal of Structural Engineers, Vol4, No1, p29
44. IEEE 524-2003 Guide to the Installation of Overhead Transmission Line Conductors

45. IEEE 738 IEEE Standard for Calculating the Current-Temperature of Bare Overhead Conductors
46. IEEE 951 -1996 Guide for the assembly and erection of Metal Transmission Structures
47. IEEE 977-1991 IEEE Guide to Installation of Foundations for Transmission Line ISSC3 Guideline for Managing Vegetation Near Power Lines
48. Kiessling F, Nefzger P, Nolasco JF, Kaintzyk U. , 2002, Overhead Power Lines, Springer, New York
49. Lee C., EEP 217 Overhead Line Design – Mechanical, QUT
50. Littlejohn GS, 2008, Ground Anchorages and anchored structures, ICE, Thomas Telford, London
51. Marcus Punch - "Towards Zero Harm" –NSW DPI Electrical Engineering Safety Seminar – Nov 2009
52. Mason M, March 2007, Thunderstorm Wind Gusts in Australia, School of Civil Engineering, University of Sydney, APEC 21st Century COE Short Term Fellowship, Tokyo Polytechnic University
53. Nadimpalli K, Cechet RP, Edwards M, 2007, Severe Wind Gust Risk fo Australian Capital Cities – A National Risk Assessment approach, Risk and Impact Analysis Group, Geospatial and Earth Monitorig Division, Geoscience Australia, Canberra, Australia. Email : Krishna.nadimpalli@ga. gov. au
54. RMS of NSW Road Design Guide
55. Sanabria LA, Cechet RP, A Statistical Model of Severe Winds, Geoscience Australia Record 2007/12, Australian Government
56. S. E. Oliver, W.W. Moriarty, J.D. Holmes "A risk model for design of transmission line systems against thunderstorm downburst winds" Engineering Structures 22 (2000) 1173-1179
57. Service and Installation Rules for New South Wales
58. Southwire Overhead Conductor Manual 2nd Edition, Southwire Company, Georgia USA www.southwire. com
59. Townsend HE, 2002, Outdoor Atmospheric Corrosion, ASTM STP 1421, ASTM, Philadelphia, USA
60. UPAC Guide International Helicopter Association, UFOC Best Practices Safety guide for Helicopter Operators, Revision 12 : December 2008,
61. Vincent T. Morgan,1967, "The Current-Carrying Capacity of Bare Overhead Conductors" I. E. Aust. Power Systems Conference August 1967 paper 2326
62. Vincent T. Morgan "Thermal Behaviour of Electrical Conductors, Steady, Dynamic and Fault-Current ratings" John Wiley and Sons, Brisbane, 1991
63. Wareing B, 2002, Wood Pole Overhead Lines, IEEE P&E Series 48, IEE,
64. Wong CJ, Miller MD, Guidelines for Transmission Line Structural Loading, 3rd edit, ASCE Manuals and Reports on Engineering Practice No 74 2010

3.4 Acts and regulations

- Electricity Supply Act 1995.
- Electricity Supply (Consumer Safety) Regulation 2006
- Electricity Supply (General) Regulation 2001 (NSW)
- Electricity Supply (Safety and Network Management) Regulation 2014
- Work Health and Safety Act 2011 and Regulation 2011

4.0 DEFINITIONS

Accredited Service Provider (ASP)	An individual or entity accredited by the NSW Government Trade & Investment in accordance with the Electricity Supply (Safety and Network Management) Regulation 2014 (NSW).
Action	Force (load) applied to a mechanical system, as well as imposed or constrained deformation or acceleration, e. g. due to earthquakes, temperature or moisture changes.
Aerial Bundled Cable (ABC)	Two or more XLPE insulated aluminium overhead conductors twisted together to form a single bundled assembly.
AAC	All Aluminium Conductor
AAAC	All Aluminium Alloy Conductor
ACSR	Aluminium Conductor Steel Reinforced
ADSS	All Dielectric Self-supporting (Communications cable—optical fibre)
AHD	Australian Height Datum
Al	Aluminium
Alignment	A distance relative to the edge of the footpath (usually the property boundary side) used to describe the position of a pole, cable or other service.
Average Recurrence Interval (ARI)	Or “Return Period”, is the inverse of the annual probability of exceeding wind speed, as applied in AS/NZS 1170. 2
Blowout	The horizontal ‘sag’ or deviation of powerline conductors from the centre as a result of wind forces.
Bridging	Relatively short, flexible or rigid, bare, covered or insulated leads which electrically connect lines at termination or tee-off points or connect electrical lines to electrical apparatus. Also known as ‘droppers’ or ‘jumpers’.
Business Management System (BMS)	An Ausgrid internal integrated policy and procedure framework that contains the approved version of documents.
Cadastral Map	A map or plan showing details of land tenure (e. g. , property boundaries or natural features).
Chainage	The distance from a datum along the centreline of a roadway. This term and offset are used to reference points on roadworks plans.
CLAH	Current-limiting Arcing Horn, or gapped surge arrester
Common MEN System	An earthing system in which the LV MEN system is connected to the HV system earthing. This is used commonly in urban areas where there are numerous interconnected earth rods all meshed together over a wide areas and a low resistance to earth can be obtained. See ‘Multiple Earth Neutral’.
Conductor	A wire or other form of conducting material used for carrying current.
Consent to Enter	A licence to enter property for specific works with conditions (see NS109 and NS143 Easements and Ausgrid Negotiation Officers)
Covered	An unscreened overhead conductor around which is applied a specified

Conductor Thick (CCT)	thickness of insulating material dependant on the working voltage.
Creep (or Inelastic Stretch)	The process where a conductor increases in length over time when under tension in service. This causes an increase in sag in a span of mains.
CSA	Cross-sectional Area
Cu	Copper
Customer	A person or organisation that has applied for or receives electrical supply from the electricity network.
Document control	Ausgrid employees who work with printed copies of document must check the BMS regularly to monitor version control. Documents are considered “UNCONTROLLED IF PRINTED”, as indicated in the footer.
Easement	A strip of land registered on the title deed in the office of the Registrar of Titles allowing access or other rights to a public body or party other than the owner of the parcel of land on which the easement exists. (Refer to NS109 and NS143)
Earthing	The process of connecting components of electricity supply networks to ground to prevent dangerous voltages occurring which may damage equipment or injure individuals coming into contact with them.
EMF	Electromagnetic Field
Everyday Tension	The sustained load (continuous force) exerted by conductors under no wind conditions.
Feeder	A circuit (normally HV) emanating from a substation for distributing electric power.
FoS	Factor of Safety
Ground Clearance	The vertical distance between the conductor at its lowest point of sag and ground.
GL	Ground Level
HDC	Hard Drawn Copper
High Voltage (HV)	Electrical potential that is in the range of 1kV to 33kV.
Intermediate pole	Is intermediate (non-strain) pole or in line non-termination pole
King Bolt Spacing	The vertical distance between king bolt attachment points on a support structure e. g. a pole.
LIDAR	Light Detection and Ranging—a method of surveying from an aircraft, wherein a scanning laser beam is used to map ground level, conductor heights and vegetation.
Load Case	A compatible set of load arrangements or conditions to be considered in evaluating a structure, e. g. sustained load, maximum wind load, ice load.
Load Factor	A factor in a limit state equation which takes into account the variability and dynamics of a load, as well as the importance of a structure.
Low Voltage	Electrical potential that is in the range of 32V to 1kV.

(LV)	
Mains	Main lines or cables of a network connecting various sites—does not include services to individual consumers.
Maximum Wind Tension	The force applied by conductors to a support structure in an intense wind, generally a 3s gust corresponding to the overhead line design period.
Multiple Earth Neutral (MEN)	An earthing system connecting the network neutral conductors to the earth electrodes in customers' electrical installations, the electricity authority transformers and earths at multiple locations on the electricity distribution network.
Network Standard	A document, including Network Planning Standards, that describes the Company's minimum requirements for planning, design, construction, maintenance, technical specification, environmental, property and metering activities on the distribution and transmission network. These documents are stored in the Network Category of the BMS repository.
Non-Strain Pole	Is intermediate (non-strain) pole or in line non-termination pole
OPGW	Optical Ground Wire—an overhead earth wire with internal optical fibre/s.
Overhead Mains	Aerial conductors or cables together with associated supports, insulators and apparatus used for the transmission or distribution of electrical energy.
Phasing	The relative positions of phases (A,B, C) in a polyphase power system.
Pole	A structure (wood, concrete, steel, composite fibre) supporting conductors and other equipment forming part of the overhead mains.
Profile	A longitudinal cross section of ground and an existing or proposed powerline used to check clearances and select optimum pole positions.
RL (Reduced Level)	The elevation of a point above an adopted datum.
Ruling Span	A theoretical span used to represent the behaviour of a number of spans of varying lengths in a strain section of an overhead powerline, also known as Mean Equivalent Span.
SF	Safety Factor, also Strength Factor
Sag	The vertical distance between a conductor and a line joining the two attachment points. Usually the term refers to the maximum distance within a span at or near the midpoint.
SC/GZ	Steel Conductor/Galvanized
Semi-urban	(Intermediate design historically exists, being between Urban & Rural, but may not be permitted new in ES 8 Clause 1. 1) Check specific case 'Design Information' for specific zoning category and limits.
Service	The electricity authority's conductors connecting individual customer's installation to the electricity network.
Serviceability Limit State	State beyond which specified service criteria for a structure or structural element are no longer met.

Sinking Depth	The depth of a pole below ground—also known as embedment or planting depth.
Span	A section of overhead conductor between two supporting poles or structures. The term may also refer to the horizontal distance between the two pole attachment points.
Span Reduction Factor (SRF)	A reduction applied to design wind pressure on conductors on long spans taking into account that wind gusts tend to be localised in their intensity.
Stay	A steel wire that is used to support a pole when the tip load exceeds the pole capacity. The stay may be anchored in the ground or to another pole. Also known as a 'guy'.
Strain Point	The structure on a pole that supports the tension of a line in both directions, where conductors are terminated, as opposed to an intermediate support. Used to sectionalise a line for electrical isolation or to provide convenient stringing sections. Also known as a 'Shackle Point'.
Strain pole	Conductor termination pole
Strain Section	A section of overhead powerline between fixed strain points or terminations.
Strength Factor, or Strength Reduction Factor	A factor in a limit state equation used to derate the nominal strength of a component to a practical design value, taking into account variability of the material, workmanship, maintenance and other factors.
Stringing Table	A table providing stringing tensions and/or sags for a nominated conductor over a range of span lengths and conductor temperatures.
Subcircuit	A circuit or below another circuit above, e. g. LV mains below 11kV.
Supercircuit	A circuit or above another circuit below, e. g. 11kV mains above LV.
Single Wire Earth Return (SWER)	A high voltage system consisting of a single active conductor and using the earth as the return path.
Review date	The review date displayed in the header of the document is the future date for review of a document. The default period is three years from the date of approval. However a review may be mandated at any time where a need is identified due to changes in legislation, organisational changes, restructures, occurrence of an incident or changes in technology or work practice.
Termination Pole	Conductor strain point or termination on this pole. Can be terminal or in line termination pole.
Tip Load	The equivalent mechanical load applied to a pole tip by attached conductors or stays, as well as wind on the pole/structure.
UGOH	Underground to Overhead transition where a cable terminates on a pole.
Uplift	A vertical upward force applied to a structure by attached conductors—generally not desirable for intermediate (non-strain) structure types.
Ultimate Limit State	State associated with collapse or structural failure. Generally corresponds with the maximum load-carrying resistance of a structure or component thereof.
Ultimate Strength	The maximum load (nominal or actual) which may be applied to a structural component without inducing failure.

UTS	Ultimate Tensile Strength – the maximum mechanical load which may be applied to a conductor, beyond which failure occurs.
Very Short Spans	‘Very short ‘spans are spans with lengths below those span lengths listed in the Stringing Tables.
Weight Span	The equivalent span that gives the vertical conductor load applied to a support and equals the span between the lowest points on the catenary on either side of that support.
Wind Span	The equivalent span that gives the horizontal lateral component of the conductor load applied to a support and equals one half of the sum of the spans on either side of that support.
Working Strength	A nominal maximum working load obtained by dividing the ultimate strength by a safety factor. This value is not relevant to limit state design but existing poles may be labelled with a working strength.

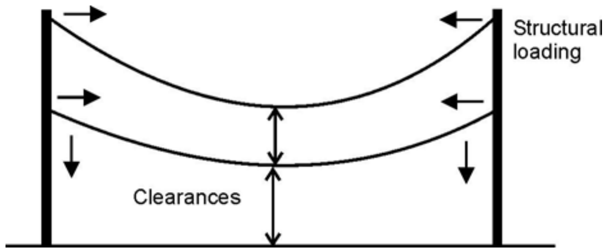
5.0 DESIGN SUMMARY

5.1 General approach and limit states

5.1.1 Design considerations and load cases

At distribution voltages, overhead line design tends to consist more of structural engineering than electrical engineering. The two main technical aspects to the design of overhead distribution lines are:

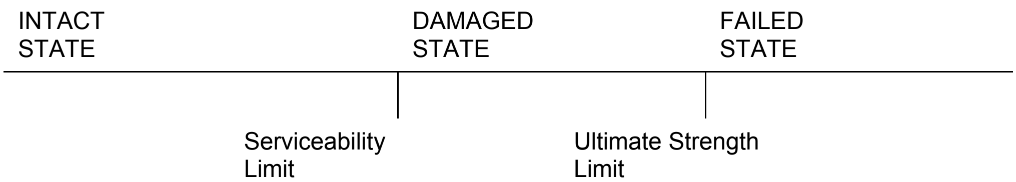
- ensuring that the mechanical load forces do not exceed the strength of the structures or other components, and
- ensuring that there are adequate clearances - between the conductors and the ground or from other objects in the vicinity of the line, as well as between the various phase conductors and circuits themselves so that clashing does not occur.



The line must comply with these requirements over the full design range of weather and load conditions that could be reasonably encountered—when the line is cold and taut, when at its maximum design temperature and consequently when conductor sag is at a maximum, and under maximum wind conditions. The load conditions to be considered for Ausgrid lines are set out in the following sections, where applicable wind pressures, temperatures and load factors are listed.

5.1.2 Limit states

For structural integrity to be maintained the structure strength must always exceed the applied mechanical load, otherwise the line passes beyond the limit of its *intact* state to a *damaged* state or *failed* state. Beyond these limits, the line no longer satisfies the design performance requirements.



This may be expressed by the following general limit state equation:

φR_n > effect of loads $(\gamma_x W_n + \Sigma \gamma_x X)$ (i. e. strength > applied loading)

where:

φ = the strength factor, which takes into account variability of the material, workmanship etc.
R_n = the nominal strength of the component
γ_x = the load factor, taking into account the variability of the load, importance of structure, dynamics etc.
W_n = wind load
X = the applied loads pertinent to each loading condition

Thus, the ***Ultimate Strength Limit*** equation used within Ausgrid, which pertains to loading under short-term wind gusts, with the appropriate load factors applied from Clause 5.2, may be expressed as follows:

$$\varphi R_n > 1.0\, W_n + 1.1\, G_s + 1.25\, G_c + 1.25 Ft_w$$

where:

W_n = effect of transverse wind load on structure
G_s = vertical downloads due to the self weight of the structure and fittings
G_c = vertical downloads due to conductors
Ft_w = conductor loads under maximum wind conditions.

Note that the limit state equation is not a simple arithmetic equation. The loads include various vector components - vertical, horizontal longitudinal and horizontal transverse. However, for simple distribution lines, downloads are often relatively minor and are not a significant contribution to an overturning moment on the pole, so are often ignored. Note, too, that the structure components have different strengths in different directions and under different actions, eg compression, tension, shear or torsion.

Apart from the Ultimate Strength Limit, Ausgrid commonly also requires checking of the **Serviceability Limit**, which addresses the effect of sustained (no wind) loading, primarily due to conductor everyday tension. This is particularly appropriate with timber components, which may deflect or deform under a sustained load. This limit state is described by the following equation:

$$\varphi R_n > 0.9\, G_s + 1.25\, G_c + 1.1 Ft_e$$

where:

Ft_e = conductor loads under everyday (no wind) conditions

This limit state approach to overhead design has been used widely in Australia since 1999. It is a rationalisation of the earlier working stress method, which applied a general factor of safety, but uses higher, more realistic wind loads (aligned with AS1170 wind code), and material strength factors more closely aligned with reliability of performance. It takes a reliability-based (acceptable risk of failure) approach. Based on this approach, Ausgrid applies an Average Recurrence Interval (ARI) of 100 years to determine minimum design wind pressures for normal distribution lines. For this ARI, the probability of the design wind loads being exceeded during a 50 year design life is only 39 per cent.

Clauses 5.2 – 5.4 present design wind loads, load factors, strength factors and design temperatures to be used for various situations and load cases.

Reference 23 also sets out other limit states that designers may need to check where relevant, such as:

- failure containment or broken wire condition (where one phase conductor breaks on one side of a strain point, so that the loads applied are then out of balance)
- maintenance and construction loading
- snow and ice loading
- seismic loading
- torsional loading
- maximum wind uplift.

5.1.3 Practical application of limit state equations

This design manual presents tables of pole strengths in section 9, along with self windage. Mechanical loads applied by conductors are presented in section 9. These tables already include the various load and strength factors. This allows designers to easily compare loads with strength in order to check pole sizing and the need for stays. Worked examples are presented in Clause 6.3.

5.1.4 General design approach

The design process is iterative. The designer initially assumes certain pole positions, pole lengths, poletop constructions and conductor stringing tensions. The design is then analysed and adjusted, sometimes several times over, until an optimum design arrangement is obtained. The final design should be one that:

- is economical (considering the whole-of-life cost), which usually means keeping structures to a minimum number, and of an economical size
- meets all applicable technical and regulatory standards (e. g. voltage drop, current capacity, adequate clearances, not mechanically overloaded)
- meets all safety and environmental standards
- is practical to construct, maintain and operate
- has adequate reliability for the intended purpose.

5.2 Load case conditions

Table 5.2.1: Load Case Conditions

<table>
<tr><th rowspan="3">Load Case</th><th rowspan="3">When to Check</th><th colspan="3">Conditions</th><th colspan="4">Load Factors</th></tr>
<tr><th colspan="2" rowspan="2">Wind</th><th rowspan="2">Temp.</th><th rowspan="2">Wind Load on Structure</th><th rowspan="2">Longitudinal Conductor Forces</th><th colspan="2">Vertical Loads</th></tr>
<tr><th>Structure Self Load</th><th>Conductor</th></tr>
<tr><td>Maximum Wind (Ultimate Strength)</td><td>All Situations</td><td>Maximum</td><td>900Pa or more Refer to Table 5.2.2</td><td>15ºC</td><td>1.0</td><td>1.25</td><td>1.1</td><td>1.25</td></tr>
<tr><td>Everyday (Sustained)</td><td>All Situations See Note 1</td><td>Nil</td><td>0 Pa</td><td>5ºC</td><td>1.0</td><td>1.1</td><td>0.9</td><td>1.25</td></tr>
<tr><td>Failure Containment (Broken Wire) See Note 2</td><td>No requirement to check for standard Ausgrid constructions</td><td>Moderate</td><td>240 Pa</td><td>15ºC</td><td>1.0</td><td>1.25</td><td>1.1</td><td>1.25</td></tr>
<tr><td>Maintenance/ Construction</td><td>No requirement to check for standard Ausgrid constructions See Note 3</td><td>Light</td><td>100 Pa</td><td>15ºC</td><td>1.0</td><td>1.5</td><td>1.1</td><td>1.5 + 2Q see Note 4</td></tr>
</table>

Notes:

1. The Everyday/Sustained Load case is normally only a limiting factor on shorter spans in tight-strung rural lines with steel or ACSR conductors. However, designers should always satisfy themselves that this condition is satisfied.
2. Failure containment case should allow for one third of phase conductors to be broken, causing an out-of-balance load on the strain structure. This check may be warranted with tight-strung rural lines.
3. Designers may wish to add notes to their design drawings indicating the need for temporary construction stays.
4. ‘Q’ refers to dynamic loads.
5. For other load cases, e. g. snow and ice, seismic, maximum wind uplift – see Reference 23.

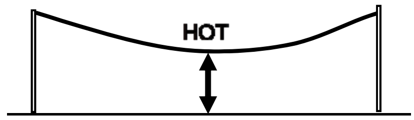
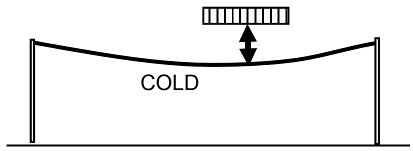
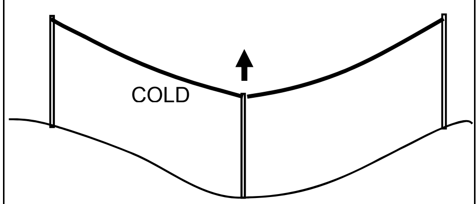
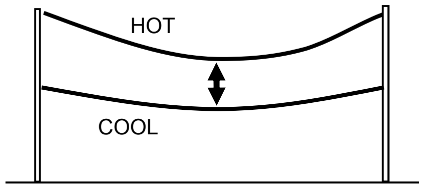
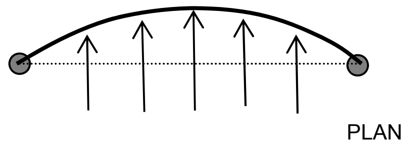
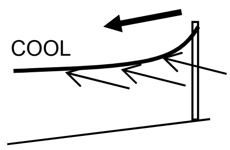
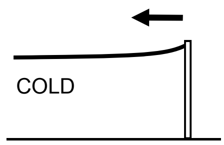
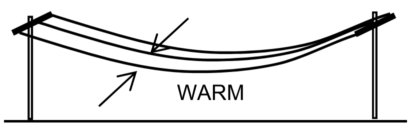
Table 5.2.2: Maximum Wind Pressures for Design

Component	Situation		Design Wind Pressure see Note 1		Remarks
	Type	Description	Prior to application of SRF see Note 2	After application of nominal SRF see Note 3	
Conductors	Urban Area	Typical built-up areas where some shielding of lines from winds is provided by buildings, terrain and vegetation	900 Pa	-	SRF may be ignored in these situations, as span lengths tend to be short.
	Rural Area	Open, exposed areas see Note 5	1180Pa	966Pa	Based upon a span length of 125m
	Microburst (Downdraft)	A localised column of sinking air from a storm cloud causing intense damaging winds, common in inland areas	1350Pa	1216Pa	Based upon a span length of 125m. Use local knowledge to determine if area is prone to these winds. www.bom.gov.au or equivalent
Round Poles			1300Pa	-	
Large Plant Items			2300Pa	-	Ignore small plant items, e.g. transformers with less than 100kV.A capacity

Notes:

1. The derivation of the various wind pressures used is presented in Clause 5.5.
2. Designers with software that can apply Span Reduction Factor (SRF) to individual span lengths should use these Pre-SRF application values.
3. Designers with software that cannot apply Span Reduction Factor (SRF) to individual span lengths should use these Post-SRF application values.
4. For additional information on SRF, refer clause 5.5.3.
5. Where a line is in an exposed area or natural wind tunnel, even if the surrounds are built up, ‘Rural’ wind pressures should be used.

5.3 Line temperature cases

Situation		Temp	When Used	
Max. Design Temp. (Hot)	Bare Mains 11kV LV	75ºC 75ºC	Checking clearance from ground or objects below the line.	 N.B. See Notes on Maximum design temperatures for all voltages at the end of this table
	LVABC, CCT	80ºC	Bare LV conductor only acceptable for existing mains. ABC to be used for all new works.	
Min. Temp. (Cold)		5ºC	Checking clearance from objects above the line	
Uplift		5ºC	Checking for uplift forces, esp. on intermediate structures	
Subcircuit		15ºC	Checking intercircuit clearance - hot supercriut above and cool subcircuit below	
Blowout		40ºC	Checking horizontal line displacement (sideways 'sag') under 500Pa wind force	
Max. Wind Condition		15ºC	Calculating mechanical forces under maximum wind	
Sustained Load Condition		5ºC	Calculating sustained mechanical forces and reference temperature for conductor stringing	
Midspan Conductor Clearances		50ºC	Checking interphase conductor spacing to avoid clashing	

Notes: Maximum design temperatures for all voltages

132kV ACSR	120°C
132kV AAC or AAAC	100°C
66kV ACSR	120°C if new. *1
66kV AAC or AAAC	100°C if new. *1
33kV ACSR	120°C if new. *1
33kV AAC or AAAC	100°C if new.*1
11kV	75°C
LV	75°C*2

*1. For existing mains, submit a request for rating to Ausgrid sub-transmission planning. Existing feeders are sometimes rated to 85°C. This may be a preferable outcome to avoid bulk replacement of structures.

*2. In some municipalities the rating of existing bare mains has been 50°C. The Ausgrid contestability officer will make the determination of the Max design temp (hot) in this case.

5.4 Strength factors for various components

Part of Overhead Line	Component	Limit State	Strength Factor Φ
Wood structures preserved by full length treatment	Pole	Strength	0.60
		Serviceability	0.34
Wood structures not preserved by full length treatment	Crossarm	Strength	0.65
		Serviceability	0.37
Fibre Reinforced Composite Structures (design based primarily on testing)	Crossarm	Strength	0.79
		Serviceability	0.32
Concrete structures	Pole	Strength	0.9
Steel structures	Pole or crossarm	Strength	0.9
Stays	Cable members	Strength	0.80
	Anchors	Strength	0.40
Conductors		Strength	0.70
		Serviceability	0.50
Fittings and pins - forged or fabricated		Strength	0.80
Fittings - cast		Strength	0.70
Fasteners	Bolts, nuts, washers	Strength	0.90
Porcelain or glass insulators		Strength	0.80
Synthetic composite suspension or strain insulators		Strength	0.5
Synthetic composite line post insulators		Strength	0.9 (max. design cantilever load)
Foundations relying on strength of soil - conventional soil testing		Strength	0.65
Foundations relying on strength of soil - empirical assessment of soil		Strength	0.6

5.5 Engineering notes

Table 5.2.2 sets out design wind pressures to be used and how Span Reduction Factor (SRF) is to be applied.

5.5.1 Basic design wind pressures

Industry practice is to consider wind loads on structures due to a 3 second wind gust that occurs over a certain return period, typically 50 – 200 years. Ausgrid use a return period, or Average Recurrence Interval, of 100 years for standard distribution lines. For this ARI, the probability of the design wind loads being exceeded during a 50 year design life is only 39%. By way of comparison, for a 50 year ARI, there is a 63% probability that actual wind speeds will exceed design wind speeds during a 50 year design life.

For the Ausgrid supply area, a 100 year ARI corresponds with a wind speed of 41m/s, or 148km/h for normal synoptic winds.

Wind pressure may be related to wind velocity using the following formula:

$$q = k V^2$$

where:

q = dynamic wind pressure (Pa)
k = a constant, typically 0.6 or 0.613, but varies with air density
V = wind velocity (m/s)

Thus, a wind speed of 41m/s equates to a wind pressure of approximately 1030Pa.

For microburst (downdraft) winds in inland areas, a 100 year ARI corresponds with a synoptic wind speed of 44m/s, or 158km/h, which equates to 1188Pa.

5.5.2 Scaling factors

Various scaling coefficients may be applied to the wind speed or wind pressure to allow for factors such as terrain (sheltered, exposed), height (10m approx. for distribution lines), wind direction, gust factor and drag coefficient (depends on size, shape, smoothness and geometry). For additional detail see References 21 and 23.

For distribution conductors, a drag coefficient of 1.16 has been applied to the basic wind pressure. Structures such as rectangular section poles or lattice towers will have larger drag coefficients than small smooth round conductors and wind pressures are scaled up accordingly.

For rural areas, a wind speed multiplier of approx. 1.0 has been used (Terrain Category 2 for open areas), giving a design wind pressure of 1180Pa. A span reduction factor of 0.82 is applied, based on a typical span length of 125m, allowing for a general design wind pressure of 966Pa.

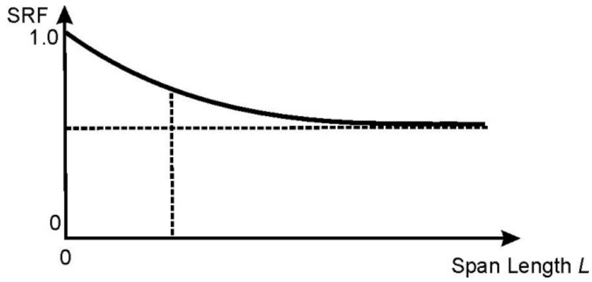
For urban areas with a higher degree of shielding, a wind speed multiplier of 0.83 would be appropriate, giving a design wind pressure of 823Pa. However, this value has been rounded up to 900Pa, a value which is used widely within the industry for distribution line design.

Designers may need to consider topographical factors appropriate to specific site conditions. For additional detail see References 21 and 23.

5.5.3 Span reduction factor

Reference 23 Annexure B5.3 also sets out calculation of Span Reduction Factor (SRF) for various types of winds acting on conductors with long spans. The wind pressure is deemed to fall away exponentially with increasing span length due to:

- the inertia of longer spans of conductor, and
- the fact that gusts or microbursts of wind may be quite localised and not at the same intensity over the entire span.



Synoptic winds: $SRF = 0.59 + 0.41\ e^{(-L/210)}$
Microburst winds: $SRF = 1 - (0.3125 (L - 200)/1000)$ for $L > 200m$

DERIVATION OF STRENGTH FACTORS FOR WOOD POLES

Reference 23 allows for loss in strength of timber poles, depending on the expected service life (degradation factor k_d = 0. 85 for treated poles over an expected life of 50 years). This value k_d is incorporated in the strength factor for a wood pole. The assumption in this value is that allowance for loss in strength is made over the expected service life and not based on the time before first inspection.

This does not match up with current inspection and change-out practices, which do not generally change poles according to age, but instead monitor the pole for loss in strength over time. A pole is condemned and replaced or reinforced after it degrades to a minimum residual strength. Ausgrid's practice is to set this point at 50% retentive strength, which is FoS = 2, based on the traditional safety factor design FoS = 4. It is important to match an allowance for degradation with retentive strength at the change-out decision point, otherwise the level of reliability at this point will be too low and higher pole failure rate should be expected.

To match a design with change-out practice, allowance for pole degradation must be such that:

- line design reliability is maintained to the Change-out Decision Point
- line design reliability continues to be maintained over the pole replacement period.

For example, for a level of design equivalent to an ARI = 100 years, that is, with a probability that design loads will be exceeded in a 50 year lifetime (39%), changing the pole out at 50% retentive strength requires an initial factor of safety of 3. 15. Presuming a maximum change-out period of 2. 5 years and a Φ = 0. 8 for visually graded timber, a Strength Factor (SF) of 0. 61 is required, which means the effective pole degradation factor (k_d) = SF/Φ = 0. 61/0. 8 = 0. 77.

Calculation

Conversion between working stress and limit states design. Factor of safety (FoS) is a measure of the level of initial design relative to a stress factor approach, applying 500Pa design wind pressure and includes an allowance for pole degradation.

Factor of Safety (FoS) = Limit state design wind pressure/500Pa/Strength Reduction Factor

Where:

The Strength Reduction Factor = $\Phi * k_d$
Φ = 0. 8 (visually graded timber)
k_d = Strength Reduction Factor

Line reliability over design life L. Based a risk assessment for rural lines, a minimum design Average Recurrence Interval (ARI) = 100 years over a 50-year project life is prescribed. This equates to a design wind pressure of 966Pa after the application of the shape factor for conductor (1. 17) and the span reduction factor for rural lines (0. 82) and allowing for a synoptic wind speed according to Region A1:

Regional wind speed V_{100} = $67 – 47ARI^{-0.1}$ = 41. 13 m/s
Design wind pressure = $0.6V_{100}^2$ *1. 17*0. 82 = 966Pa

Probability that the design wind load will be exceeded at least once in technical lifetime L:
$r = 1-(1-1/ARI)^L$ = 39%

r is an indication of line reliability, maintained over a prescribed replacement period, which is set at 2. 5 years to allow for a pole crossing the minimum strength limit in between inspections.

Line Reliability over Pole Replacement Period

The required Average Recurrence Interval to maintain design line reliability (r) over the replacement period (ARI_{rep}) = $1/(1-\exp(\ln(1-r)/L_{rep}))$

= 5. 5 years

where

L_{rep} = 2. 5 years and
r = 39%

Wind speed equivalent to ARI_{rep} over replacement period (V_{rep}) = $67 – 47ARI_{rep}$
=32 m/s

Equivalent design wind pressure over replacement period = $0.6 * V_{rep}^2$
= 631Pa

Factor of Safety (FoS) over replacement period = $V_{rep}/500/\Phi$
= 631/500/0. 8
= **1. 58**

Required Initial Factor of Safety = $\frac{\text{Factor of Safety over replacement period}}{\text{Remnant pole strength at change-out decision point}}$

= 1. 58 / 50%
= **3. 15**

Required Initial Strength Reduction Factor = Design wind pressure/500/Initial FoS
= 966 / 500 / 3. 15
= **0. 61**

Effective pole degradation factor (k_d) = $\frac{\text{Initial strength reduction factor}}{\text{Strength reduction factor after pole degradation}}$
= 0. 61 / 0. 8
= **0. 77**

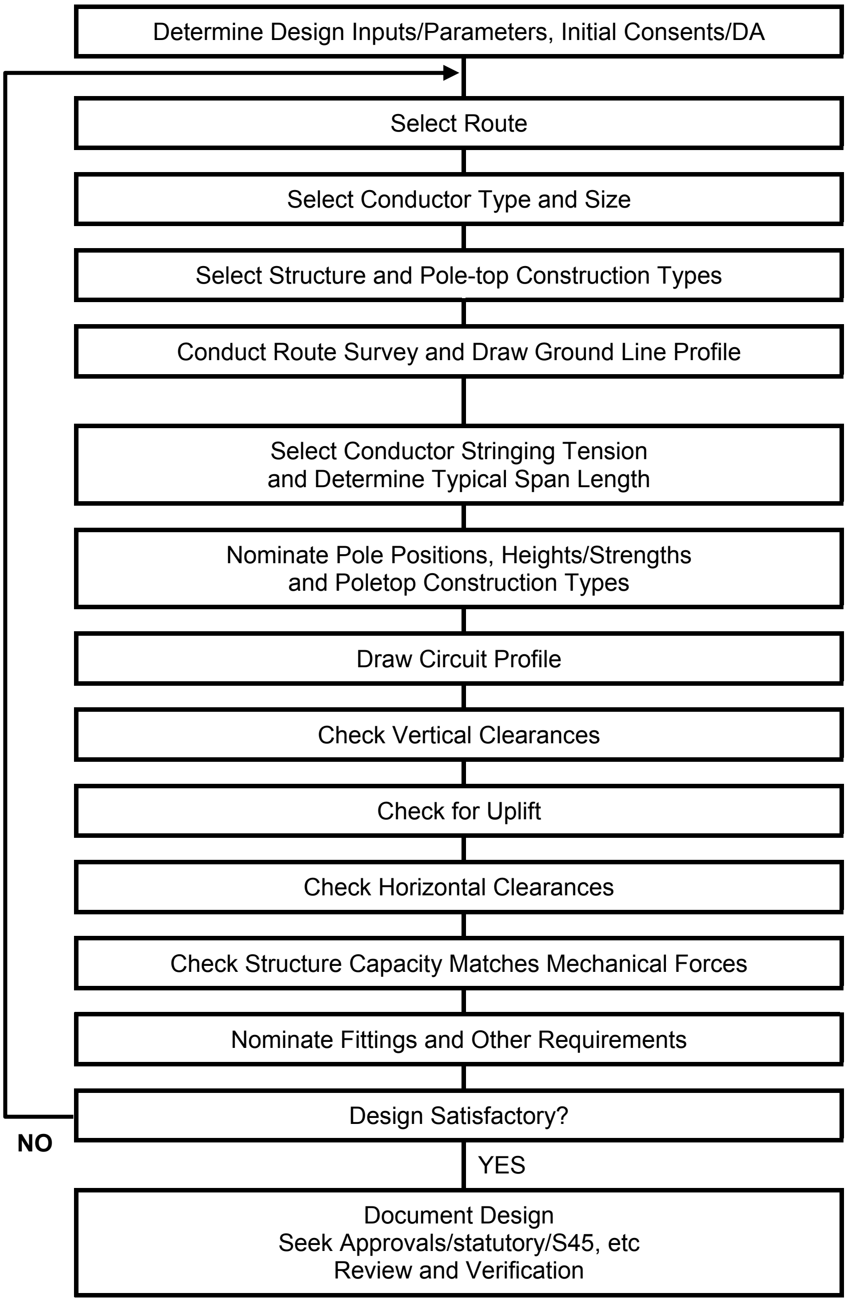
Application of a SRF = 0. 6 (with an associated pole degradation factor of 0. 75) allows for a slightly more conservative result.

6.0 DESIGN PROCESS

6.1 Flowchart of generalised overhead design process

Typical steps in an overhead distribution line design are shown below. Note that the precise steps and their sequence will depend upon the project and the context in which the design is performed.

The process is *iterative*, with the designer making some initial assumptions, e.g. as to pole height and size, which may later need to be adjusted as the design is checked and gradually refined. The optimum arrangement that meets all constraints is required as the final outcome.



6.2 Step by step guide

Typical steps in an overhead distribution line design are shown below. Note that the precise steps and their sequence will depend upon the project and the context in which the design is performed.

6.2.1 Determine design inputs/parameters

Prior to commencing design, it is important to collect and document all relevant design inputs. This may include:

- a planning report, concept, specification or customer request for supply initiating the project
- load details
- any special requirements of customers or stakeholders eg S 45, consent to enter
- planning requirements
- possible future stages or adjacent developments, road widening or resumptions
- relevant applicable standards or statutory authority requirements
- coordination with other utilities — ‘Dial Before You Dig’ results
- coordination with road lighting design
- survey plans or base maps
- environmental assessments, ecosystem maps
- any site constraints identified.
- consents

The design should be ‘traceable’ back to a set of design inputs. Persons other than the original designer should be able to review the design and see why it was done a certain way.

6.2.2 Select route

Ideally, the line route should be as short and straight as possible in order to minimise costs, minimise stays and have a tidy appearance. However, numerous other factors need to be taken into account, such as:

- property issues, ease of acquisition of Ausgrid property rights over private lands
- ease of obtaining approvals from statutory authorities
- community acceptance
- minimising vegetation clearing, environmental and visual impact, EMF impact
- access for construction, maintenance and operations
- for low voltage lines, ease of servicing all lots
- compatibility with future development
- suitable ground for excavation and pole foundations.
- Minimising terminations constructions

6.2.3 Select conductor size and type

Preferred conductor sizes and types for various applications are presented in Clause 7. 1. Factors influencing selection include:

- load current and whether the line is ‘backbone’ or a spur
- voltage
- fault levels
- environmental conditions - vegetation, wildlife, pollution or salt spray
- compatibility with existing adjacent electrical infrastructure
- required span lengths and stringing tension.
- Future requirements of line planning

6.2.4 Select overall structure and poletop construction types

Typical pole sizes are presented in Clause 9.1. Designers should make allowance for any future subcircuits likely to be required when sizing poles, as well as any streetlighting brackets to be attached.

Clause 11.1 compares the performance of various types of pole-top construction, e. g. horizontal vs vertical.

Clause 11.6 presents requirements for siting pole-mounted plant.

6.2.5 Conduct route survey and draw ground line profile

(or modern technological equivalent method) must be in accordance with NS104

The line route is ‘surveyed’ to determine:

- details of existing electricity infrastructure
- terrain and site features, e.g. trees, access tracks, fences, gullies.
- ground line rise and fall along the route.

Ground line profiling may not be necessary for minor projects in urban areas where the ground is reasonably level or has a consistent slope throughout and there are no on site obstructions. The designer can check ground clearances by simply deducting the sag in the span from the height of the supports at either end.

However, ground line profiling is essential where:

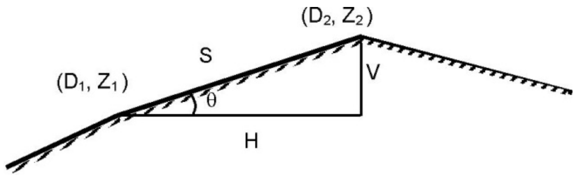
- poles have to be positioned along an undulating traverse
- there is a ‘hump’ or change in gradient in the ground midspan
- outside of urban areas where spans are comparatively long—say in excess of 80m
- the designer has doubts as to whether required clearances will be met (ground or intercircuit or over some structure such as a streetlight column)
- where uplift on poles is suspected.
- The equipment used to obtain measurements will depend on complexity of project. For many distribution lines, a simple electronic distance measuring device and inclinometer are adequate. Elsewhere, use of a total station, a high-end GPS unit or LiDAR may be warranted. The route is broken up into segments, typically corresponding with ‘knee points’ or changes in gradient. Slope distance and inclination measurements for each segment can be converted to chainage and reduced level (RL) values to facilitate plotting as follows:

$H = S \cos \theta$

$V = S \sin \theta$

$D2 = D1 + H$

$Z2 = Z1 + V$



Where the slope angle θ is small (<10°, say), then we may assume $H = S$ for simplicity.

A table of the format illustrated below can then be produced. The starting RL can be either a true AHD height measurement or some arbitrary value, e. g. 100m.

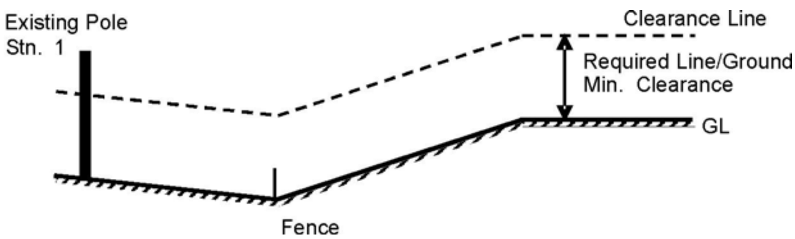
Description	S (m)	θ	H (m)	V (m)	Chainage (m)	RL (m)
Station 1					0	100. 00
	35	-2°	35	-1. 22	35	98. 78
Lot Boundary	67	+4°	67	+4. 67	102	103. 45
	22	0°	22	0	124	103. 45
Station 2						

The data in the Chainage and RL columns can be plotted on graph paper using appropriate scales, e. g. 1:1000 or 1:2000 horizontally, 1:100 or 1:200 vertically. The vertical scale is deliberately larger than the horizontal in order to exaggerate any slopes and clearance issues.

Various line design software packages or spreadsheets are available to automate plotting of survey data.

Apart from the ground line, various features and stations must be shown—existing poles, gullies, fences, obstacles, roadways.

A clearance line is then drawn offset from the ground line, according to the minimum vertical clearances that apply (refer Clause 13.1). For example, for a bare 11kV line over a carriageway of a road, the clearance line would be 7.5m above the ground line. This line shows the lowest level to which the line may sag under maximum load conditions. The clearance line height may vary along the route, according to the circumstances that apply, e. g. whether along a footpath, over a carriageway or a non-trafficable area.



Note: Each specific Design Software can display clearance lines and alerts in different formats.

6.2.6 Select conductor stringing tension and determine typical span length

Clause 8.1 discusses selection of a suitable stringing table which matches the typical span length along the route.

In urban areas, the positioning of poles on alternate lot boundaries along the roadway tends to keep spans relatively short, and eliminates line encroachments. Insulated/covered cables have lesser spanning capability than bare conductors.

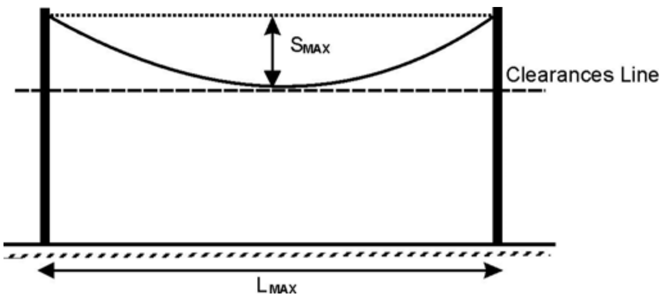
The spacing between ridges in undulating terrain can also be a factor in determining suitable span lengths.

6.2.7 Nominate pole positions

Clause 9.5.3 provides guidance on preferred locations as well as locations to be avoided.

Firstly, position poles along the route at any key or constrained locations, e. g. end points, bend points, positions required for supporting street lighting or on alternate property boundaries in urban areas to facilitate servicing each lot with non-encroaching services.

Next determine the maximum span length that can be achieved over flat ground given the attachment heights on poles, the sag at the nominated stringing tension and the required ground clearance. Also check the spanning capability of the poletop constructions to be used, as set out in Clause 11.3. Position poles along the route so that this spacing is not exceeded. Of course, if there are gullies between poles, the spacing can be increased; if there are 'humps' mid-span, reduce span lengths.



6.2.8 Nominate strain points, pole details and poletop constructions

Strain point (i.e. 'through-termination') locations need to be determined. These should be used:

- to isolate electrically different circuits
- to keep very short spans or very long spans mechanically separate, such that all spans in a strain section are of similar length (no span less than half or more than double the ruling span length, and on tight-strung lines, the longest span not more than double the shortest span). **Failure to limit span variance can cause excess sagging in longest span at higher design temperature loadings.**
- to isolate critical spans, e.g. spans over a river, major highway or railway line, to help facilitate repairs or maintenance
- on line deviation angles too great for intermediate constructions, e. g. crossarms with pin insulators
- at locations where there are uplift forces on poles
- at intervals of approximately 10 spans or so. It is helpful if this length corresponds with the output of a conductor stringing work crew for a day. Strain constructions can also limit the length of line affected in the event of wires brought down in a storm. Also, the length of conductor on a drum may be a consideration.

Keep the span lengths within the strain section reasonably similar, if possible. Also, keep the type of pole and poletop construction used reasonably consistent, as this gives the line a tidy appearance.

The designer will need to nominate pole strengths and foundation types/sinking depths as a first pass, knowing that these may need to be amended later once tip loads are checked. Heavier poles will be used at terminations and on large deviation angles. Pole sinking depths can be determined in accordance with Clause 9.3 or Clause 9.2.

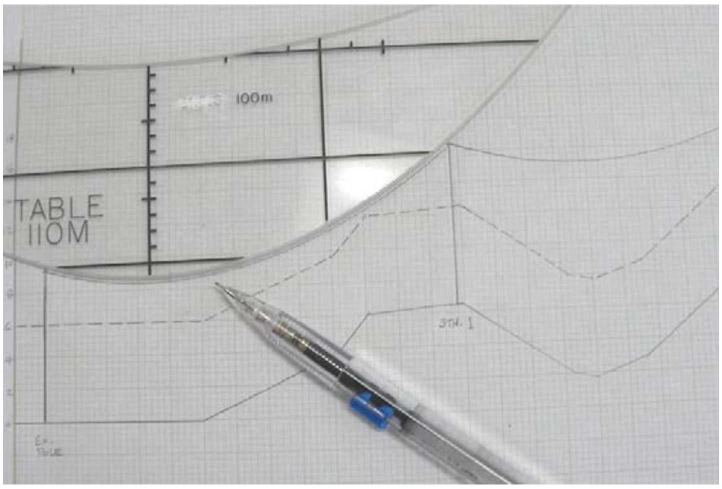
The designer will need to nominate suitable poletop constructions for intermediate poles with adequate capacity for the deviation angle at each site (refer Clause 11.3).

6.2.9 Draw circuit profile

The line profile may be generated with software or drawn manually. The purpose is to verify that vertical clearances are adequate.

Poles are drawn to scale on the profile, with marks placed at the support points for each circuit. The latter can be determined by reference to Ausgrid Standard Construction drawings.

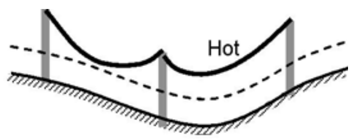
The conductors may be drawn using a sag template matched to the conductor type, stringing tension and ruling span (refer Clause 6.6 for details of how to construct a template). The template is positioned to link the two support points for the circuit. The bottom curve of the template is used for drawing the conductor at the maximum design temperature, the top curve for the cold or uplift condition.



The datum lines on the template must be aligned with the grid of the graph paper. The template should not be tilted.

6.2.10 Check vertical clearances

Ground clearance can be checked by ensuring that the 'hot' curve does not fall below the clearance line offset from the ground line.



If there is insufficient ground clearance, the designer may need to:

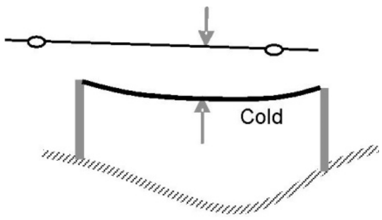
- reduce span length
- increase stringing tension
- increase pole height
- adjust pole positions to try to fit in better with the terrain.

Where there are long spans with a supercircuit and a subcircuit, intercircuit clearance should be checked. The supercircuit will be drawn at the maximum design temperature and the subcircuit at the 'cool' temperature, 15°C.

If there is insufficient intercircuit clearance, the designer may need to:

- reduce span length

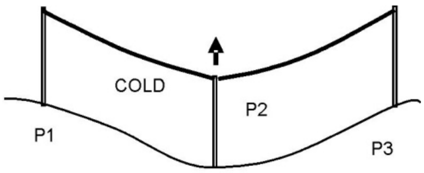
- increase stringing tension on the supercircuit
- reduce stringing tension on the subcircuit, provided that there is adequate ground clearance
- increase the spacing between the supercircuit and subcircuit at the supporting poles.



For checking **clearances from an object above the line**, the line temperature should be taken to be 5°C. This temperature is also used when checking for uplift on structures.

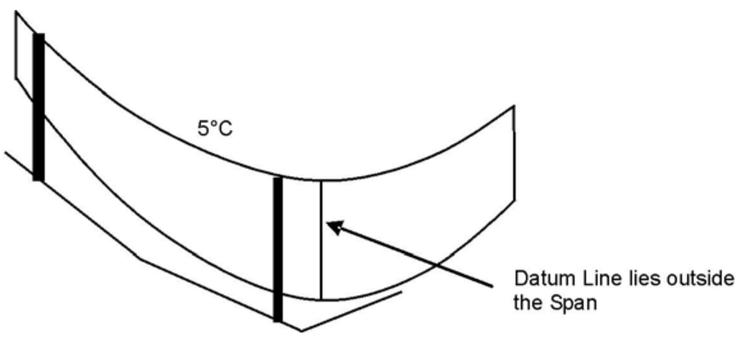
6.2.10.1 Check uplift condition

Poles at the bottom of a hill or in a gully are prone to uplift. Under cold conditions, the conductors heading up the slope will become tight and pull upward on structures, causing damage. The 5°C curve is used for this check from attachment height on P1 to attachment height on P3, to check P2 in between for uplift. Uplift will be evident where the template does not touch /meet conductor attachment height at P2. If you are profiling with a template and the datum of the template (low point of the sag curve) lies outside the span, as illustrated below, uplift is present. Thus the conductor rises immediately adjacent to the support rather than dropping down.



Uplift is generally not a problem if it is on one side of the structure only and offset on the opposite side by a downward force, as may occur with a line with successive spans running down a steep slope. However, if on both sides of an intermediate structure such as a suspension or pin construction, it needs to be addressed. Possible solutions include:

- changing the poletop construction to a through-termination or uplift type construction
- moving the pole to a different location
- reducing stringing tension
- increasing pole height
- reducing heights of adjacent poles, subject to adequate ground clearance being available.

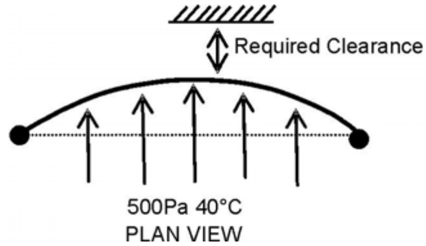


Uplift is managed in different ways in line design software packages. It is important to verify how to conduct this important check.

6.2.11 Check horizontal clearances

The designer should check that there are adequate horizontal clearances between the line and any nearby structures (eg flag poles, buildings, bridge columns, streetlight columns) or embankments.

(**Refer Clause 13. 1 Dimension ‘F’** for allowable clearances.) These clearances should be checked for both – (**a) the no wind condition** and **(b) the blowout conditions.**



Ways of addressing horizontal clearance problems include:

- increasing conductor stringing tension
- reducing span length
- relocating poles to a different alignment
- ensuring that poles are placed in line with any objects, so that there is nil blowout
- using different poletop constructions, e. g. vertical construction
- using insulated cables rather than bare conductors
- relocating objects affected, where feasible, e. g. streetlights
- increasing line height to skip over the object, where feasible.

6.2.12 Check structure capacity matches applied mechanical forces

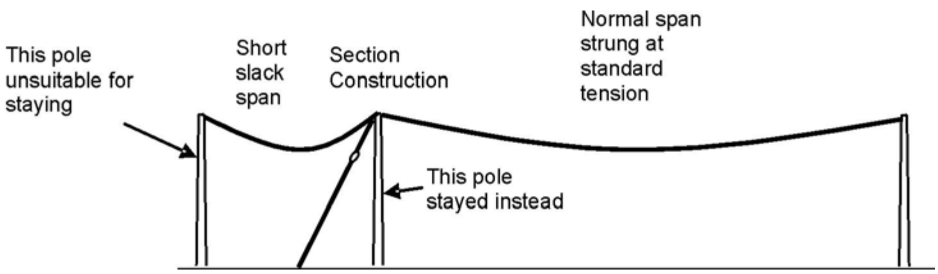
Tip load calculations should be undertaken for each of the poles, in the line. Forces exerted by conductors are detailed in Clause 12.1. Conductors attached significantly below the tip have their applied force scaled down proportionately. Forces are added as vectors, not scalar quantities unless in the same direction.

Self-windage of poles is given in Clause 9.2. Wind loading of large transformers is detailed in Clause 11.6.

The applied tip load is then compared with the capacity of the pole, as detailed in Clause 9.2.

Where the pole has more than adequate strength, the designer may investigate whether it is feasible to drop down to a smaller size, e.g. from a 12kN to an 8kN working strength. This may mean an adjustment to sinking depth as a consequence, which will affect the profile marginally.

Where the pole has insufficient strength, the designer will usually consider increasing pole size, or else fitting a stay, if space permits. Details of stay types, sizing and positioning are given in Section 10. Where space for a stay is restricted or a pole is unsuitable for staying, the designer may reduce stringing tensions, or even use a short, slack span, then stay the next pole along, as shown below.



The decision to use a stay should be a last resort, especially in high traffic, livestock movement or arable cropping land areas.

6.2.13 Nominate rittings and other requirements

- The designer will need to provide additional details concerning things such as:
- fitting of vibration dampers (refer Clause 11.7)
- wildlife proofing (refer Clause 11.7)
- details of clamps, lugs, connectors, sleeves, bridging (as per Standard Constructions)
- details of pole-mounted plant, fusing and settings (refer Clause 11.6)
- earthing (refer Section 14)
- lightning and surge protection
- services and phasing (refer Clause 11.4)
- vegetation clearing requirements (refer Clause 13.8 and ISSC3 and NEG-OH21)
- special foundations (refer Clause 9.3)
- access tracks
- Ausgrid property rights

6.2.14 Modify design until compliant and optimal

The design process is iterative. The initial first-pass design is 'tweaked' repeatedly until it complies with all regulations and stakeholder requirements and is optimal in terms of cost, reliability and practicality for construction, maintenance and operations.

6.2.15 Document design

A project design plan should be prepared in accordance with NS104.

Usually a bill of materials or resource estimate is also generated at this stage. (Local Work Procedure and often its a feature of design software.)

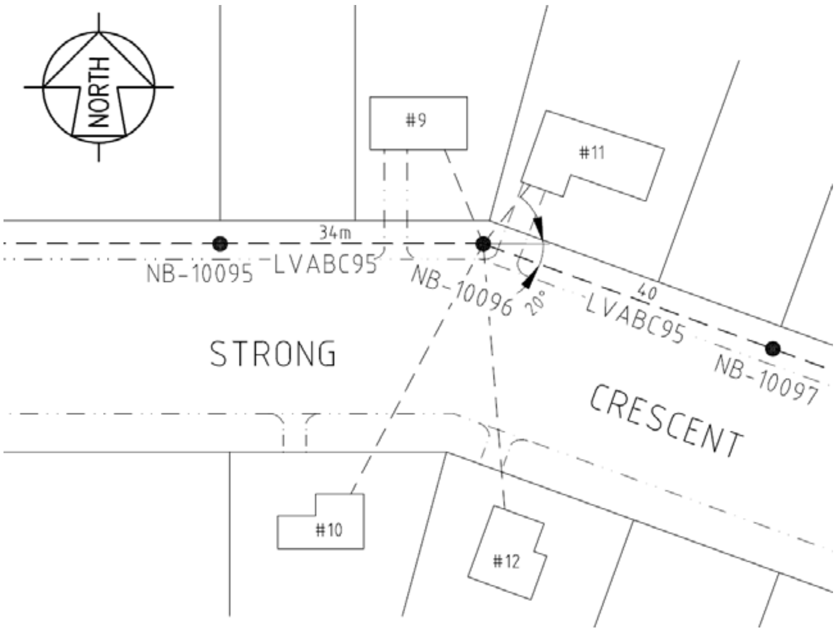
The design should be thoroughly checked prior to issue. A typical checklist is provided in Clause 6.5. The designer should ensure that all aspects have been addressed. For major projects independent review and verification of the design may be carried out.

6.3 Worked examples

Example 1 – Simple condemned LV pole replacement

A low voltage pole in a suburban street, NB-10096, has been condemned and requires replacement. The existing pole is an old natural round type 30' long on a 3. 0m alignment, 1. 2m behind the kerb. The pole supports 4C 95mm^2 LV ABC mains and has an intermediate suspension angle type poletop construction with a 20° deviation in the line. There are 4 single phase services to houses, all 25mm^2 aluminium/XLPE types in good condition.

The sag in the 40m span was measured at 1. 04m on a sunny but breezy day with an ambient temperature of 25°C. The soil type seems to be very stiff clay, well-drained.



We need to replace the pole adjacent to the existing one, typically offset by 1 metre. Given the proximity of the driveway to #11 to the east, we decide to replace the pole 1m to the west. Looking at the services, it seems that this small relocation will not cause any aerial infringements over private property.

We will allow the pole to remain on the existing pole alignment. It is a single pole on an existing overhead line in an established residential area, where road widening is unlikely and the setback is sufficient so that it is not a significant hazard to vehicles. Of course, we will check 'Dial Before You Dig' plans and check on site to verify that this location is clear of underground services. If we have any doubts in this regard, we will place a warning note on our design plan and specify hand sinking of the pole.

The length of LVABC mains is essentially unaffected by the pole relocation, so there is no need to sleeve in any additional mains or re-tension the mains. We will specify that the services to #9 and #10 on the western side of the pole be transferred to the new pole. However, the services to #11 and #12 on the eastern side of the pole will now be too short and will need to be replaced, making sure that we have adequate ground clearance throughout.

From Clause 9.1, we see that 11m is the standard length for LV poles. As the mains are not tight and the deviation angle is moderate, we will start by nominating only a 6kN working strength (24kN ultimate) pole. From Pole Data (Clause 9.2), we see that for this pole size we have:

- 8. 23kN sustained load capacity
- 14. 44kN maximum wind condition capacity
- 1. 53kN self-windage
- 1. 90m sinking with concrete backfill in 600mm diameter hole.

Now we need to determine the stringing tension of the existing mains. The spans in the vicinity are around the 40m mark, so we consult the stringing tables for LVABC RS=40m for both 2%UTS and 6%UTS (refer Clause 8.3 sheets 52 and 53), the two most likely stringing tensions in this urban situation, to see which is the best fit. We look at the row for a 40m span and the column for 30°C (5°C above ambient, say, as the day is sunny). We find that the 6%UTS table (Clause 11.3 Sheet 53) corresponds best with our measured sag (1.08m).

Knowing the stringing tension, we can now turn to Clause 12.1.5 to determine the forces applied by the conductor to the pole tip. For 6% UTS and a 20° deviation angle, we note that the sustained load is 1.21kN and the maximum wind load is 6.18kN. We need to add the self-windage of the pole, 1.53kN, to the latter figure, giving a max. wind load of 7. 71kN. Service loads are ignored.

We now compare applied loads with pole capacity and find that the 6kN pole size we have nominated is satisfactory.

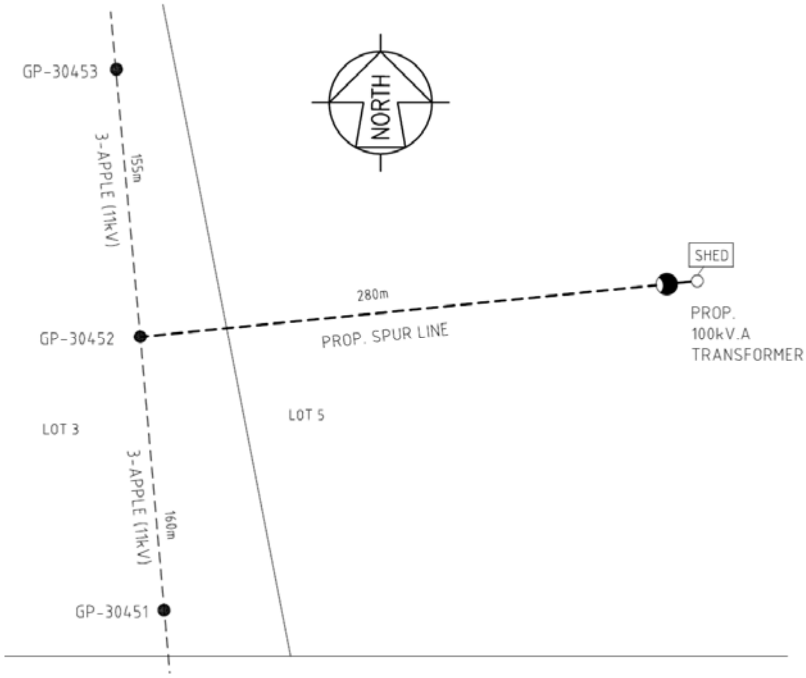
Load Case	Applied Load	Capacity
Sustained	1.21kN	8.23kN
Maximum Wind	7.71kN	14.44kN

Now we turn to Clause 11.3.2 to verify that the poletop construction 1-73 (LVABC angle) can handle the 40m span and 20° deviation angle, and see that it is well within the limitations. (We cannot simply replace like with like, as many existing aspects of the network do not meet current network standards.)

We make a final check that the mains will have adequate clearance from ground. The 40m span is the longer of the two adjoining the pole. Turning to stringing table 8.3. Sheet 53 and the 80°C column, we find that the sag is 1. 33m at max. design temperature. The tip of the pole is 9.10m high, and the LVABC will be supported approx. 0. 25m below this (refer construction drawing for 1-73), i. e. at a height of 8. 85m. Assuming that the adjacent pole NB-10097 is of a similar height, then the mid-span ground clearance of the LVABC will 8. 85 – 1.33 = 7.52m. This is well above the required 6. 0m (refer Clause 13.1.2 dimension ‘B’).

Example 2 – Short HV rural extension to transformer over flat ground

Prepare a design for a 280m spur line from an existing rural 11kV ACSR line to a new 100kV. A pole substation. Beyond this, a15m span of 95mm^2 LVABC is required. The existing pole GP-30452 is a 12.5m 6kN (working stress) 24kN (ultimate) pole embedded 2.3m in the ground, and the existing cross-arm for the small delta construction (2-5) is at a height of 10. 0m. The ground is very stiff clay and essentially flat, and the terrain is open. Existing pole GP-30452 has been inspected and found to be in excellent condition below ground.



There are no issues with vegetation or wildlife, so we will use bare mains. We will select APPLE (6/1/3. 00 ACSR/GZ) conductor for the spur line and use RURAL stringing of 22. 5% UTS.

We consult stringing table Clause 8. 3. Sheet 42 (250m RS) and find that if we try to span 280m without any intermediate poles, we will have a sag of 7. 84m at max. design temp. of 75ºC. This will be excessive for regular height poles. (Even if we change to RAISIN conductor as per table 8. 3. Sheet 50, we would have a sag in excess of 5. 0m, which is still a bit high in this case.) We therefore opt for an intermediate pole. Let us place it halfway along the route, creating two 140m spans. We can use the stinging table for a 150m RS Clause 8. 3. Sheet 40. The sag in each span will be 2. 49m at 75ºC, which will leave us plenty of ground clearance.

We will string the 15m span of 95mm^2 LVABC slack, i. e. at 2% UTS as per stringing table 8. 3. Sheet 51. The sag is only 0. 47m at max. design temp. of 80ºC.

Now for the intermediate 11kV pole, we nominate a 12. 5m height, in keeping with the pole selection guidelines in Clause 9.1. We nominate a 4kN/16kN type, as it is only an intermediate pole supporting light conductors. Using the pole data table in Clause 9. 2, we nominate 2.02m sinking depth, with concrete backfill and a 600mm diameter auger. (We could use the Foundation Design Spreadsheet for this later to see what other alternatives exist.)

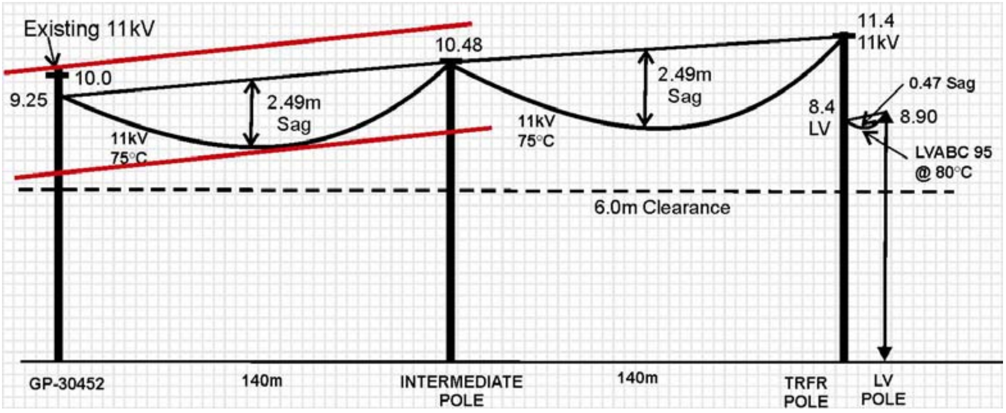
On the intermediate pole we will use a small delta construction (2-5), similar to that used on the main line. From Clause 11. 3 we can see that easily handles the 140m spans. The tip height will be 10. 48m, and the crossarm 10. 28m. The outer phase conductors will be at a height of 10. 48m.

For details of the transformer pole, we refer to Clause 11.6.2 and the table showing vertical spacings. For a 14m 12kN/48kN pole, we have a sinking depth of 2. 40m. As a plant pole, we will use a concrete foundation, and from Clause 9.2.1, an auger diameter of 750mm. The tip height will be 11.6m. The 11kV termination (2-10) will be at height 11.4m (0.2m below tip). The LV termination (1-71) will be 3. 2m below the tip at a height of 8. 4m.

For the LV Pole at the end, we will use a 11m 6kN/24kN size. According to table 9.2.1 this needs to be sunk 1.90m with a concrete foundation, 600mm dia. auger. The tip height will be 9.10m, with the LV termination (2-10) attached at a height of 8. 90m.

At pole GP-30452, the tee-off termination (2-10) will be 0.75m below the existing crossarm, at a height of 9.25m (refer Clause 13.2.2 for intercircuit clearances).

We can now draw a profile of the line, as shown below, as we have calculated all the attachment heights and sags. We could use software for this, a sag template constructed as per Clause 6.6, or simply hand draw the catenary curve on graph paper as shown below. The ruling span for the 11kV line section is 140m, as the two spans are identical length. There is more than the required 6. 0m ground clearance (refer Clause 13.1.2).



We now need to calculate tip loads for the poles and determine if any stays are required.

For pole GP-30452, we can ignore the existing mains, because the forces to north and south will cancel. We only need consider the new circuit to the east. Turning to Clause 12.1.3 for a termination of APPLE at 22. 5% UTS, we find that we have a sustained load of 3 x 3. 60kN = 10. 80kN and a max. wind condition (rural) of 3 x 10. 91 = 32. 73kN. To the latter we add pole windage of 1. 83kN (refer table 9.2.1) to get 34. 56kN max. wind load. For simplicity we will ignore the fact that the tee-off is slightly below the tip. Now, this exceeds the capacity of the pole given in table 9.2.1 (8.19kN sustained and 14.37kN max. wind), so the pole will require staying.

The force carried by the stay wire on pole GP-30452 under max. wind conditions will be 34. 56 / cos 45º = 48. 88kN, so we will require a 19/2. 00 stay wire (refer Clause 10.3.1). Looking at Clause 10.2.2, we nominate a single helix 200mm dia. screw anchor. Assuming the soil to be ‘good’ category 3, we nominate an installation torque of 5600N. m or 6 shear pins.

For the intermediate pole, we have nil sustained load and 3 x 2. 05kN = 6. 15kN conductor windage and 1.55kN pole windage, totalling 7.70kN under max. wind conditions. This is within the 9.46kN capacity of the pole.

For the LV pole at the end, we have an applied tip load of 1. 15kN sustained and 3.55kN max. wind condition from the LVABC95 (refer Clause 12.1.5), plus a pole windage of 1. 53kN, giving a total of 5. 08kN. This is within the capacity of the pole (8.23kN sustained, 14.44kN max. wind) and no staying is required. Note that we have ignored the loading of the service to the shed.

For the transformer pole, we have the following forces:

		Sustained	Max. Wind	
To west	3-APPLE	10. 80kN	32. 73kN	(refer Clause 12. 1. 3)
To east	LVABC95	1. 15kN	3. 55kN	(refer Clause 12. 1. 5)
	Pole windage _		2. 77kN	(refer Clause 9. 2. 1)
	Trfr. windage _		0. 75kN	(refer Clause 9. 6. 2)

For simplicity we will conservatively assume the pole and transformer windage load to be to the west, although in reality the worst case will be when the wind is blowing from the north or south applying the greatest force to the 11kV mains running east-west. Thus, we arrive at a resultant tip load of 11.95kN sustained and 39.80kN max. wind condition. This exceeds the capacity of the pole (16. 43kN sustained, 28.83kN max. wind) and therefore we will need to backstay the pole.

The force carried by the stay wire on the transformer pole under max. wind conditions will be 39.8/cos 45º = 56. 28kN, so we will just manage with a 19/2. 00 stay wire (refer Clause 10.3.1). Looking at Clause 10.2.2, we nominate a single helix 200mm dia. screw anchor. Assuming the soil to be ‘good’ category 3, we nominate an installation torque of 5600N. m or 6 shear pins.

If there are animals grazing in the paddocks, we may wish to consider fitting rails/guards to the stay wires.

Given the tight stringing and open countryside, we need to fit vibration dampers to each end of the two new spans of 11kV mains.

The transformer will require separate HV and LV earthing as it is a rural situation and there is no interconnection with the external LV network.

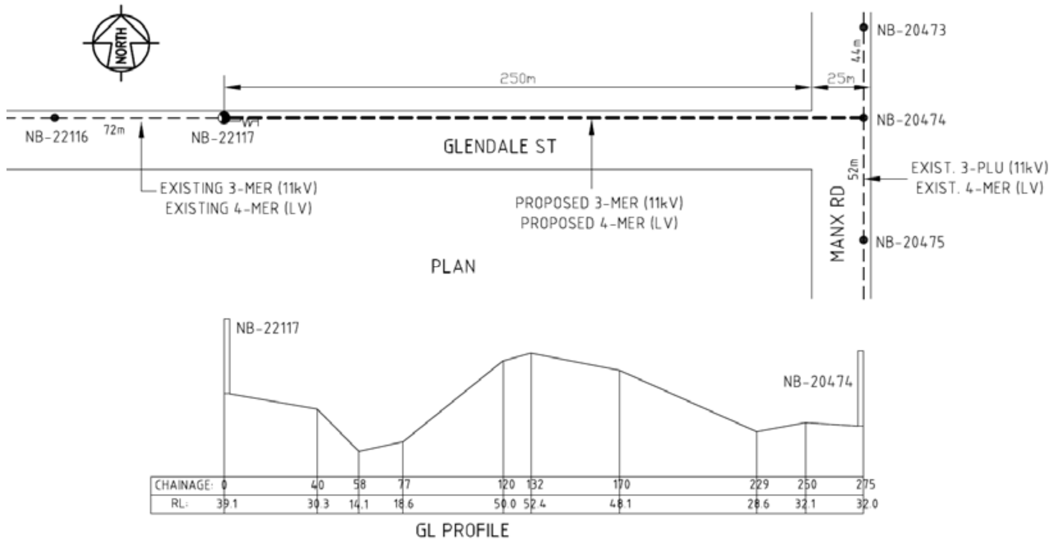
We will require a wayleave or easement to be granted by the owners of Lot 3 giving their consent for the erection of the new spur line over their property.

Example 3 – HV/LV extension over undulating ground

Prepare a design for a 250m section of new 11kV and LV line along Glendale St. between poles NB-22117 and NB-20474. Mercury conductor (7/4.50 AAC) has been nominated by the planner for the project for both HV and LV circuits. The ground is shale and has the profile shown below and the countryside is quite open. There are no lot boundaries along the route and no constraints on pole locations.

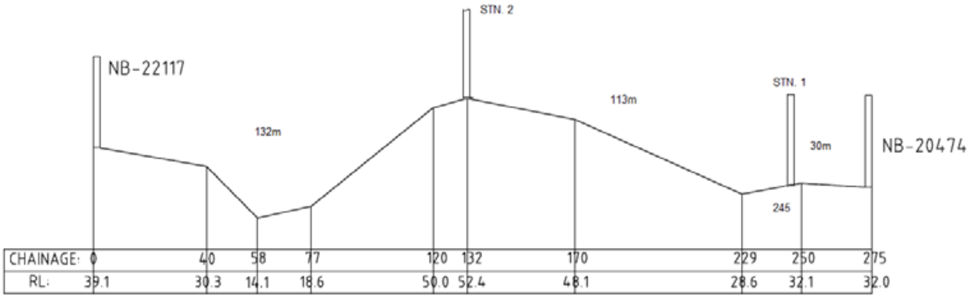
Substation pole NB-22117 is a 14m pole sunk 2. 5m deep, 8kN/32kN strength, with the 11kV termination at a height of 11.3m and the LV termination at a height of 8.8m. The pole base has been inspected recently and found to have negligible deterioration. The existing 11kV and LV conductors in Glendale St. are strung at 12%UTS.

Pole NB-20474 is a 14m pole sunk 2.2m deep, 6kN/24kN strength, with the 11kV pin crossarm at a height of 11.6m and the LV pin crossarm at a height of 9.1m. It is on an alignment of 2.55m from the real property boundary. The pole base has been inspected recently and found to have negligible deterioration. The adjacent poles in Manx Rd, NB-20473 and NB-20475, are 12. 5m 6/24kN poles, with 11kV crossarm at a height of 10. 3m and LV crossarm at a height of 7.7m. The existing 11kV and LV conductors in Manx Rd. are strung at 6%UTS.



Teeing off the existing line in Manx Rd will present a challenge because existing pole NB-20474 is only 6/24kN strength and the footpath is not wide enough to install a sidewalk stay (refer Clauses 10.3.2 and 10.5.2). So we will need to use slack stringing (2%UTS) for the tee-off from NB-20474. (Alternatively, we could place a ground stay into private property, subject to obtaining consent from the landowner, or replace NB-20474 with a heavier pole, but for this example we will use a slack span) We will place a new strain pole, Station 1, 30m west of NB-20474.

This leaves us a balance of 245m. Given the distance and the ridge midway, we will try to cover this in two spans. We place an intermediate pole, Station 2, at the top of the ridge, giving us two spans, 113m and 132m. For spans of this length, 12%UTS stringing would be adequate, especially with the gully in the middle of the 132m span (refer Clause 8.1).



For station 1, let us use a 12. 5m 12/48kN pole, as there is a change of stringing tension on the through termination constructions. From table 9.2, we nominate a sinking depth of 2.28m. (We may trim up foundation depths at a later stage using the Foundation Design Spreadsheet.) The height of the tip will be 10. 22m, the 11kV crossarm (construction 2-10) 0. 2m below at 10. 02m, the LV (construction 1-10) a further 2.5m below at 7.52m.

For station 2, let us use a 12. 5m 6/24kN pole, as it is an intermediate pole only. From table 9. 2, we nominate a sinking depth of 1. 84m. The height of the tip will be 10. 66m, the 11kV crossarm (construction 2-5) 0.2m below at 10. 46m, the LV (construction 1-1) a further 2. 5m below at 7. 96m. We can assume that the conductors are at a height 200mm above the crossarm king bolt.

Now, on pole NB-20474, the new 11kV termination will be 0. 75m below the existing 11kV crossarm at a height of 10. 85m. We will also need to lower the existing LV crossarm to a height of 8.35m so that we retain our 2.5m live line working space between HV and LV. The LV termination is 0. 75m lower again, at a height of 7. 60m.

We need to check that lowering the LV crossarm on NB-20474 does not create any problems with ground clearance in Manx Rd. Let us consider the 52m span between NB-20474 and NB-20475. The LV mains are 7. 80m high on NB-20474 and 7.90m high on NB-20475 (200mm above the crossarm, say), averaging 7. 85m. Now the sag in the 52m span at 75ºC (6%UTS assuming 60m RS – refer chart 8. 3. Sheet 4) will be 1.48m. Subtracting this from 7. 85m leaves us with 6.37m, which exceeds the minimum ground clearance required of 6. 0m (refer Clause 13.1.2), and so lowering the crossarm will not be a problem.

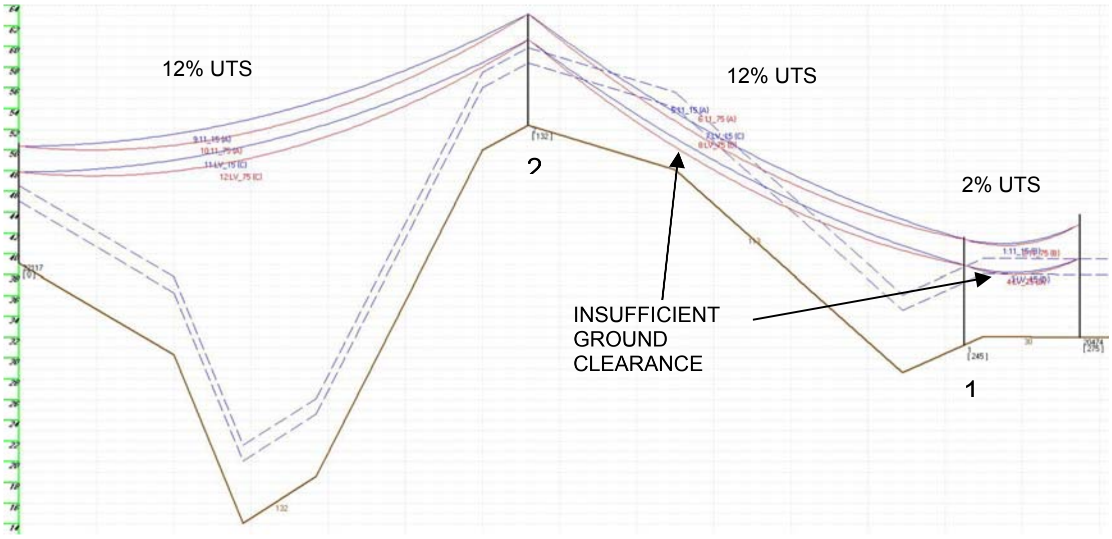
For the new line segment with two spans, the ruling span can be calculated from the span lengths as follows:

$$RS = \sqrt{\left[\frac{(132^3 + 113^3)}{(132 + 113)}\right]} = 124\text{m}$$

From stringing chart, table 8.3. Sheet 9 (AAC 12%UTS 100m RS), we note that the sag in the two spans is as follows:

Length	15ºC	75ºC
132m	2. 64m	5. 29m
113m	3. 61m	3. 88m

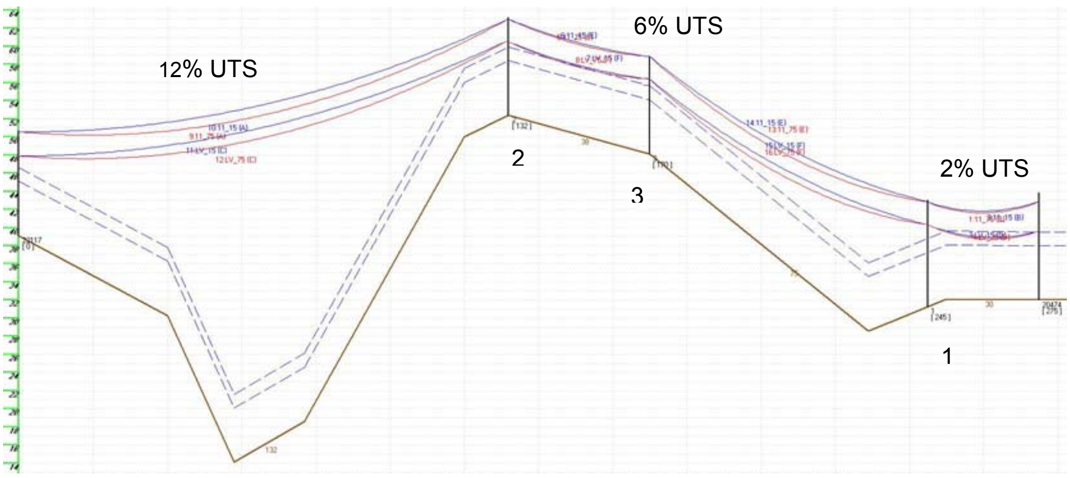
For the short 30m span, we use chart 8. 3. Sheet 1 (AAC 2%UTS 20m RS). We have 1. 10m sag at 15ºC and 1. 50m sag at 75ºC.



This gives us the line profile shown above. This could be prepared using software, a sag template or hand drawing the catenary curve on graph paper. We have shown both 75 ºC and 15 ºC curves.

We can see from the profile that there are problems with ground clearance. If we increase the height of the pole at station 1 to 14m, we correct the problem with LV Ground clearance in the slack span.

However, to fix the ground clearance problem between stations 1 and 2 proves more difficult. Increasing pole height a size or two is not sufficient, nor is increasing stringing tension to 20% UTS. We find it necessary to install another pole, station 3. We will place it at chainage 170m, on the 'knee point' or edge of ridge, giving us a 38m span and a 75m span. Now we will need to change the constructions at station 1 to through-terminations, i e make this a strain pole. We will use constructions 2-11 and 1-11. This is necessary so that we do not violate the 2:1 rule for span lengths within a strain section. Also, this allows us to drop the stringing tension between stations 1 and 2 to 6% UTS.



Note that the RS for the two span segment between stations 1 and 2 has now changed:

$$RS = \sqrt{\left[\frac{(43^3 + 70^3)}{(43 + 70)}\right]} = 61m$$

The sags in each span, from table 8. 3. Sheet 4 (AAC 6% UTS 60m RS) are as follows:

Length	15ºC	75ºC
43m	0. 75m	1. 02m
70m	1. 97m	2. 70m

Looking at the profile, we can see that we have adequate ground clearances, as well as adequate intercircuit clearance (between the 11kV at 75ºC and the LV at 15ºC).

We now need to calculate tip loads for the poles and determine if any stays are required.

For pole NB-22117, we have Mercury conductor strung at 12%UTS to both the east and the west on both 11kV and LV. These forces will all cancel under sustained load conditions. We can therefore recover the existing stay as it is now redundant. Under maximum wind conditions, the tip load will be 1. 74kN per conductor (refer table 12.1.1 Mercury 12% 0º deviation), or a total of 12. 18kN, if we ignore the fact that the LV is a 2. 5m down from the pole tip. Add to this the pole windage of 2.77kN (from table 9.2.1), giving a total of 14. 95kN. This is less than the 28. 83kN capacity (from table 9.2.1), so the pole is OK to remain in service.

For station 2, we have Mercury conductor strung at 12%UTS to the west for both 11kV and LV. To the east we have Mercury conductor strung at 6% UTS for both 11kV and LV. Given that this is now a strain pole with a change of tension on it, we will upsize it to a 12kN/48kN strength, and increase sinking depth to 2. 28m (refer table 9.2.1). According to table 12.1.1 we have the loadings shown below. Note how we multiplied by the number of conductors, and by the relative height of attachment for the LV circuits. For the max. wind case, we have also added pole windage from table 9.2.1.

Sustained

West 3 x 2. 22 + 4 x 2. 22 x 7. 52 / 10. 02 = 13.32kN
East 3 x 1. 11 + 4 x 1. 11 x 7. 52 /10. 02 = 6.66kN
Resultant 6. 66kN to west

Max. Wind

West 3 x 8. 93 + 4 x 8. 93 x 7. 52 / 10. 02 = 53. 58kN
East 3 x 5. 02 + 4 x 5. 02 x 7. 52 /10. 02 = 30. 12kN
Pole Windage 2. 38kN
Resultant 25. 84kN to west

From Clause 9.2, we see that the pole has a capacity of 16. 52kN sustained and 28. 98kN max. wind, which exceeds the loads shown above and so no staying will be required.

Station 3, as an intermediate pole (12. 5m long 4kN/16kN), will have no sustained load on it, but will have a wind condition tip load of:

3 x 0. 99 + 4 x 0. 99 x 8. 38 / 10. 88 = 6. 02kN conductor windage (from 12.1.1)
1. 55kN pole windage (from table 9.2)
Total: 7. 57kN

This is less than the 9. 46kN capacity of the pole (from table 9.2.1) and so there is no need to increase pole strength.

For station 1, we have Mercury conductor strung at 6% UTS to the west for both 11kV and LV. The pole is 14m long sunk 2. 28m. To the east we have Mercury conductor strung at 2% UTS for both 11kV and LV. According to table 12.1.1 we have the loadings shown below.

Sustained

West 3 x 1. 11 + 4 x 1. 11 x 9. 02 / 11. 52 = 6. 81kN
East 3 x 0. 33 + 4 x 0. 33 x 9. 02 /11. 52 = 2. 02kN
Resultant 4. 79kN to west

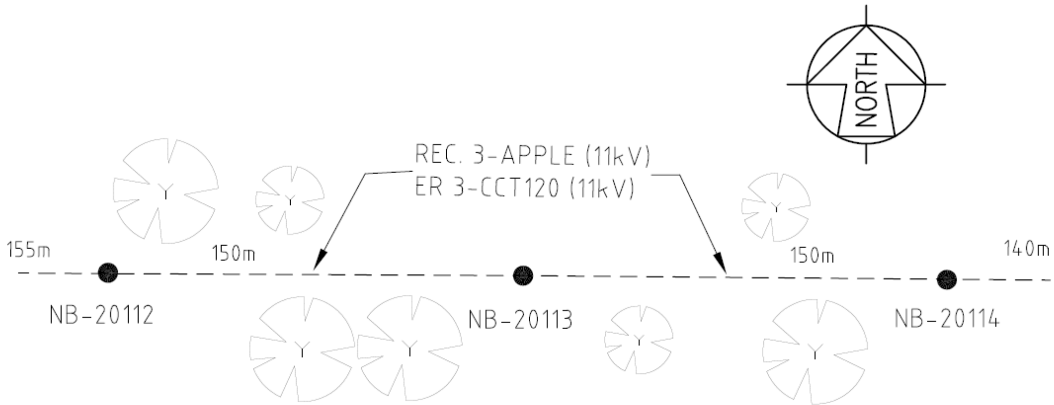
Max. Wind

West	3 x 5. 02 + 4 x 5. 02 x 9. 02 /11. 52 = 30. 78kN
East	3 x 1. 43 + 4 x 1. 43 x 9. 02 /11. 52 = 8. 77kN
Pole Windage	2. 77kN
Resultant	24. 78kN to west

From Clause 9. 2, we see that the pole has a capacity of 16.43kN sustained and 28. 83kN max. wind, which exceeds the loads shown above and so no staying will be required.

Example 4 – Reconductoring HV line segment

Two spans of an existing ACSR 11kV line require reconductoring with 120mm^2 CCT to address reliability problems due to large trees in the vicinity of the line. The existing conductor is strung at a tension of 22.5% UTS. The existing poles are 12.5m 6kN / 24kN types embedded 2.3m in the ground. The ground is reasonably level and the soil type is dense fine sand, well-compacted.



The tightest stringing table for CCT is 10% UTS. For a 150m span, there would be a sag of 6. 9m in the conductors when at their max. design temp. of 80ºC (from table 5. 3. 69 for CCT 10% UTS 150m RS). This would be excessive and there would be insufficient ground clearance. Therefore we will install two intermediate poles, creating four spans of 75m length. From stringing table 8.3.Sheet 67 (CCT 10% UTS 75m RS), we note that the sag at 80ºC would be 2.30m.

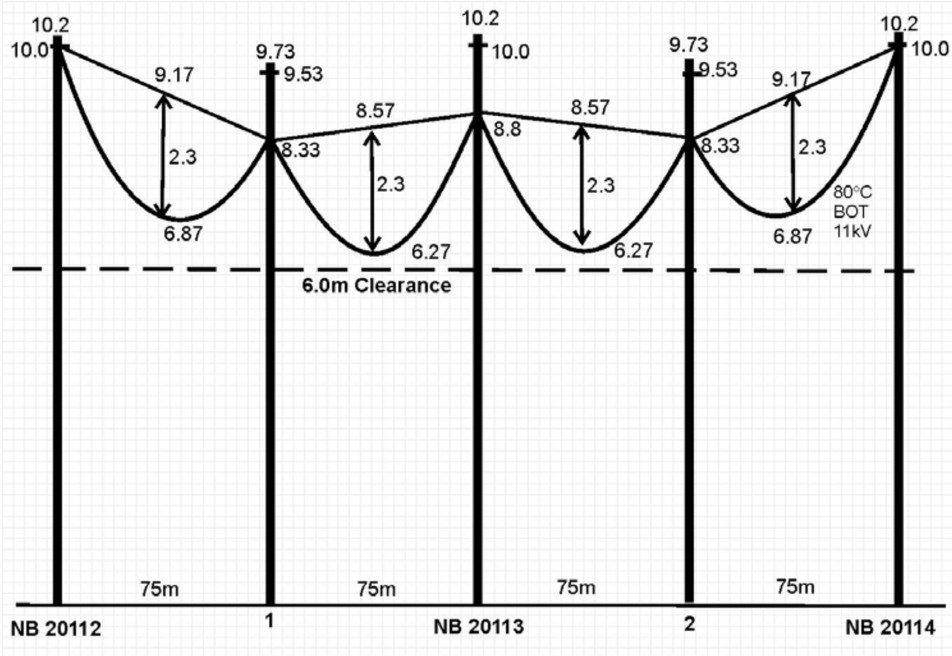
Let us nominate 12.5m 6kN / 24kN poles for the two new intermediate positions. According to table 9.2.1 we will need to sink these 2.77m. (We may be able to reduce this later by use of the Foundation Design Spreadsheet.) This gives us a tip height of 9.73m.

We will nominate a Delta Pin Post construction 2-200CCT for all the intermediate poles, as this is reasonably compact and no crossarms are needed. The top conductor will then be 0. 2m below the tip of the pole and the bottom conductor 1. 4m below the tip, i. e. at 8. 33m for the two new poles and 8. 8m for existing pole NB-20113.

At existing poles NB-20112 and NB-20114 we will replace the 11kV construction with a 2-411 CCT-to-Bare Through Termination, at a height of 10. 0m.

We now prepare a profile of the line to check ground clearances, as shown on the following page. As it is very simple, we will prepare it by hand on graph paper. We need only show the lowest 11kV conductor, at 80ºC. We are just above the 6.0m clearance line, so the design is acceptable.

Nonetheless, we consider increasing pole size in case there is a future requirement for LV mains below the 11kV. However, we would need to increase the poles by two sizes to 15.5m in order to gain the required additional height, which does not seem warranted.



Now we need to calculate pole tip loads and turn to Clause 12.1.8 to find mechanical loads for 120mm^2 CCT. We will use 'Urban' wind pressures since the vegetation provides shielding of the line from wind.

For the intermediate poles, we have nil sustained load. The max. wind load from conductors will be 3 x 1.98 = 5. 94kN. Adding the pole windage of 1.83kN, we get a total of 7. 77kN. This is less than the 14. 37kN max. wind capacity of the pole and so strength is adequate. In fact, we notice that we could drop down to a 4kN / 16kN pole, which has a 9.46kN capacity. However, this may preclude adding any future LV circuit.

For the through termination poles, we have the following loads:

Sustained

CCT120 @ 10%UTS	3 x 2. 96 = 8. 88kN
Apple @ 22. 5%UTS	3 x 3. 60 = 10. 80kN
Resultant	1. 92kN toward Apple conductors

Max. Wind

CCT120 @ 10%UTS	3 x 9. 94 = 29. 82kN
Apple @ 22. 5%UTS	3 x 10. 43 = 31. 29kN
Pole Windage	1. 83kN
Resultant	3. 30kN toward Apple conductor

These loads are small since there is good cancellation of the forces in the two directions - the Apple is lightweight but tight strung, the CCT is heavy but only has moderate tension. The pole capacity is 8.19kN sustained and 14.37kN max. wind. so no staying is necessary.

We will need to install CLAHs and associated earths to protect the line against lightning damage and nominate the two intermediate poles for this, giving us protection toward each end of the line.

6.4 Design documentation requirements

The Design Documentation Requirements for auditable substantiation are listed in NS104 with extra items in NS135 for subtransmission lines.

These deliverable design outputs should be provided to Ausgrid by ASPs, as applicable.

Ausgrid designers should ensure that comparable information is readily accessible in project files.

This Design Documentation is also important for facilitating future Design Information for redesign and for emergency restoration repairs to the line assets during their service life.

6.5 Typical checklist for overhead distribution design

Refer to Ausgrid website for NS104.

Item Description	Check
PROJECT BRIEF AND CONCEPT	
Electrical Load Assessments	
Electrical Configuration—isolation, ties, operational requirements, reliability considerations	
Equipment selection, load currents, fault levels, voltage drop, regulation, protection schemes	
Operating Environment—winds, lightning, pollution, rainfall, ground conditions (swampy, rock excavation), wildlife, traffic	
Ageing Assets and Maintenance Issues	
Asset ownership, joint use poles	
Property Issues	
Route selection	
Access—gates, fences, waterways, crops, track width and condition, slopes, construction vehicles, clearing	
Vegetation and environmental	
Safety issues	
Community issues and cultural heritage	
Coordination with other services, lighting	
Future development, coordination with adjacent projects	
Construction issues	
LINE DESIGN	
Pole types and sizes, reinforcement	
Pole foundation types and sinking depths	
Pole alignments and setbacks	
Stay types, size and orientation	
Tip load calculations	
Inspection of existing poles with increased tip loads	

Item Description	Check
Suitable poletop constructions for span lengths and deviation angles	
Strain points	
Insulator selection	
King bolt spacing	
Conductor size and type	
Conductor stringing tension	
Creep allowance	
Ruling span, span length range within strain section	
Ground and conductor profiles, temperatures	
Ground and intercircuit clearances	
Blowout and horizontal clearances	
Midspan clashing	
Uplift	
Bridging	
Phasing	
Earthing	
Lightning protection	
Vibration protection	
Services	
Conductor fittings—sleeves, clamps, markers, spacers, terminations	
PLAN AND DRAFTING	
North pointer, scale, symbols and legend	
Line types and text, differentiation between existing and proposed assets	
Dimensions/coordinates	
Street names, lot/house numbers, parks	
All relevant features shown—embankments, waterways, boundaries, buildings, other utilities, access tracks	
Pole and site numbers	
Project numbers for all stakeholders	
Schematics	
Schedules	
Contact details	
Notes and cautions	
Title Block, amendment and revision status	
Accuracy and clarity	

Notes

1. This checklist is illustrative only. It is primarily for checking technical aspects of the design and works drawing. A separate checklist may be required to address process and Ausgrid issues.
2. The ‘Check’ column should be marked ‘Y’ or ticked if correctly addressed, ‘N’ or crossed if not correctly and adequately addressed, or ‘NA’ if not applicable.
3. For additional requirements, refer NS104.

6.6 Sag template construction

(Parabola approximation, Sag = $wL^2/8T$)

Nowadays, line profiling is usually performed with software. However, on occasions it may be necessary to profile a segment of line manually using graph paper and conductor sag templates. The general procedure for sag template construction is set out below.

Determine the scales that will be used for the profiling. (Typical scales are 1:1000 or 1:2000 horizontal, 1:100 or 1:200 vertical.) The scales deliberately exaggerate the vertical dimension so that vertical clearances can be checked. The ground line and proposed poles are plotted, as described in Clause 6.2.

Determine the longest span that will need to be drawn with the template. Add approximately 60% to this length to determine the overall length of the template you will construct. In this way the template will be a comfortable size and also be suitable for use with any inclined spans that are not symmetrical about the low point.

Determine a suitable RS for the template. Ideally the template will only be used for spans in the range 70% - 150% of the RS; otherwise errors become significant.

Determine the maximum design temperature at which the conductor will be operated, eg 75°C for bare mains, 80°C for LVABC or CCT. (Refer Clause 5.3)

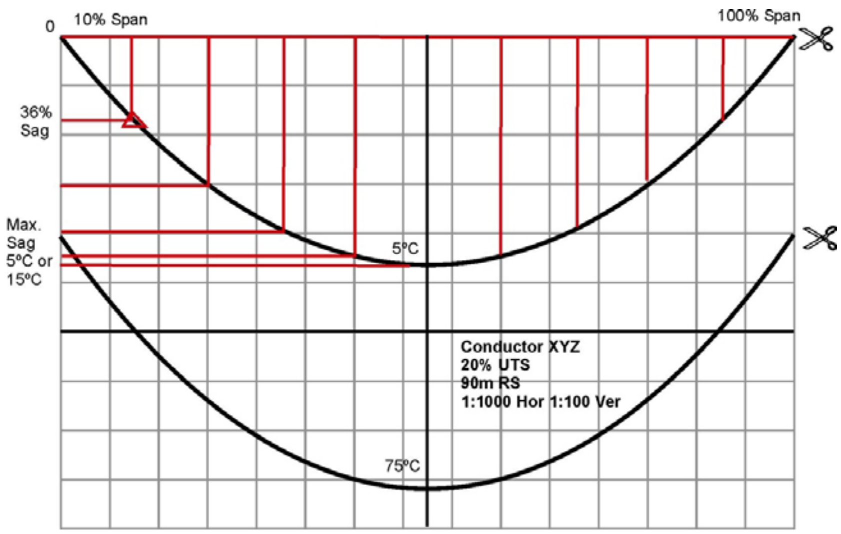
Determine the stringing tension to be used. (Refer Clause 8.1)

Determine the sags in a span of the length of the template, with the prescribed RS, at both 5ºC and the maximum design temperature. (Refer stringing tables in Clause 8. 3)

Using graph paper, plot a parabola representing each temperature/sag. The 5°C or 15°C curve should be placed at the top of the template, the maximum design temperature at the base, offset by several centimeters. Use the proportions shown in the figure in Clause 8.5 sheet 3 to plot intermediate points along the parabolas, e.g. at 10% of the span length, sag is 36% of the maximum value.

Draw in horizontal and vertical datum lines, so that the template can be properly aligned. Label the template with the type or class of conductor, e. g. AAAC, the stringing tension, the RS, the temperature for each curve and the horizontal and vertical scales used. (Do this between the two sag curves.)

Photocopy onto transparent plastic sheet (if possible). Cut out along the top (5°C/15°C) and bottom (max. design temp.) curves.



6.7 Survey and measurement

This is catered for in separate training course notes.

7.0 CONDUCTORS AND CABLES

7.1 Selection

7.1.1 Insulated/covered

TYPE	APPLICATION	NOMINAL SIZES	TYPICAL APPLICATION
LVABC (LV Distribution)	• Preferred cable type for all new LV mains • Unsuitable for long spans—not suitable for tight stringing	95mm^2	Normal residential areas
		150mm^2	Commercial/industrial areas with loads in range 200A – 280A.
		2 x 95mm^2	Where loads are likely to exceed 280A. Parallel at 100m intervals max.
CCT (HV Distribution)	• Where there is a significant risk of tree branches or wind-blown debris contacting the mains • Where wildlife is likely to initiate faults • Where reduced tree-trimming profiles are required • Where there is a significant risk of mains being contacted by cranes, jibs, boat masts or hang gliders • Where mains are in close proximity to structures • CCT is more costly than bare AAC and should not be used unless warranted for the particular site conditions • Unsuitable for long spans (>120m, say)—not suitable for tight stringing • Weight and wind loading is greater than for bare conductors and may cause excessive loading on structures • Unsuitable for railway crossings	80mm^2	Spur lines, rural areas with light loading
		120mm^2	Normal feeder segments
		180mm^2	Main feeder 'trunk' emanating from a substation or to supply large loads >370A

7.1.2 Selection: bare

TYPE	APPLICATION		NOMINAL SIZES	TYPICAL APPLICATION
AAC	LV	• Where LVABC is unsuitable for use, e. g. long spans • For repairs or minor modifications to existing mains • Ausgrid approval must be granted to use bare conductor.	MERCURY 7/4. 50	Normal feeder segments
			PLUTO 19/3. 75	Main feeder ‘trunk’ emanating from a substation or to supply large loads >320A
	HV	• Standard conductor for new HV mains, except for sites where use of CCT is warranted. • Has good conductivity and low weight. • For very long rural spans, ACSR may be preferable to AAC.		
ACSR	• Good for long, tight-strung spans in rural areas where electrical loads are light • Has greater strength than AAC, but inferior conductivity • Corrosion of steel strands can be a problem for lines close to coast, particularly on smaller size conductors • Conductors such as RAISIN’ (3/4/2. 50) may be unsuitable in the vicinity of a zone substation due to the high fault levels on the network		APPLE 6/1/3. 00	Spur lines, rural areas with light loading
			CHERRY 6/4. 75 + 7/1. 60	Normal feeder segments
AAAC (Alloy 1120)	Generally not preferred, but may be required for long rural spans in coastal areas where ACSR would suffer from corrosion		CHLORINE 7/2. 50	Spur lines, rural areas with light loading
			HYDROGEN 7/4. 50	Normal feeder segments
			KRYPTON 19/3. 25	Main feeder ‘trunk’ emanating from a substation
HDC (copper)	Obsolete — use for repairs or minor modifications to existing mains			
SC/GZ (steel)	Obsolete — use for repairs or minor modifications to existing mains			

7.2 Electrical properties and ratings

Material	Conductor Name	CSA (mm2)	Strands (No. /Dia.)		DC Resistance @20ºC (Ω/km)	Current Rating (A)						Fault Rating 1s (kA)
			Metric (mm)	Imperial (inches)		55ºC (Older Lines—see Note 2)		75ºC (Bare) Normal Distribution Lines		100ºC Subtransmission Lines / Emergency Rating		
						Summer Day	Winter Night	Summer Day	Winter Night	Summer Day	Winter Night	
AAC (1350)	LEO	34. 36	7/2. 50		0. 833	100	171	152	203	194	233	3. 2
	LIBRA	49. 48	7/3. 00		0. 579	123	215	190	255	243	293	4. 6
	MARS	77. 31	7/3. 75		0. 370	157	285	249	338	320	389	7. 2
	MERCURY	111. 30	7/4. 50		0. 258	191	357	308	424	399	487	10. 3
	MOON	124. 00	7/4. 75		0. 232	203	382	329	454	426	522	11. 5
	NEPTUNE	157. 60	19/3. 25		0. 183	230	445	379	529	494	608	14. 6
	PLUTO	209. 80	19/3. 75		0. 137	266	532	449	632	588	727	19. 4
		298. 16	19/4. 47	19/. 176	0. 096	320	670	557	796	736	916	27. 6
	TAURUS	336. 70	19/4. 75		0. 086	336	716	593	851	785	980	31. 2
	TRITON	408. 70	37/3. 75		0. 071	368	808	663	961	882	1107	37. 8
	URANUS	506. 00	61/3. 25		0. 057	404	922	750	1098	1003	1265	46. 8
AAAC (1120)	CHLORINE	34. 36	7/2. 50		0. 864	99	169	151	201	193	232	3. 1
	HYDROGEN	111. 33	7/4. 50		0. 266	189	354	307	422	398	486	10. 2
	KRYPTON	157. 62	19/3. 25		0. 186	229	442	377	526	492	605	14. 4
HDC (Hard Drawn Copper)		16. 84	7/1. 75		1. 060	84	139	127	167	160	190	3. 0
		21. 99	7/2. 00		0. 815	99	167	64	83	81	95	3. 9
		41. 58	7/2. 75		0. 433	140	242	218	291	280	336	7. 4
		59. 70	19/2. 00		0. 303	172	306	274	369	353	425	10. 6
		97. 80	19/2. 56	19/. 101	0. 186	225	416	369	503	479	580	17. 3
		112. 90	19/2. 75		0. 160	244	457	404	553	524	638	20. 0
		134. 30	19/3. 00		0. 134	268	510	449	618	584	713	23. 8
		129. 16	37/2. 11	37/. 083	0. 141	261	496	436	600	567	692	22. 9
		219. 80	37/2. 75		0. 082	350	693	601	841	790	972	38. 9

Notes for 7.2:

1. Conductors other than current preferred sizes are included for reference purposes.
2. Older lines were designed at various temperatures typically ranging from 50°C to 65°C.
3. Conductor data is generally in accordance with Australian Standards. Note that product from various manufacturers may differ slightly from the above data.
4. Refer Clause 7.5 for parameters used to calculate ratings.

Material	Conductor Name	CSA (mm2)	Strands (No. /Dia.)		DC Resistance @20ºC (Ω/km)	Current Rating (A)						Fault Rating 1s (kA)
			Metric (mm)	Imperial (inches)		55ºC (Older Lines—see Note 2)		75ºC (Bare) Normal Distribution Lines		100ºC Subtransmission Lines / Emergency Rating		
						Summer Day	Winter Night	Summer Day	Winter Night	Summer Day	Winter Night	
ACSR/GZ	ALMOND	34. 36	6/1/2. 50		0. 975	92	158	141	187	179	215	2. 6
	APPLE	49. 50	6/1/3. 00		0. 677	113	199	175	236	224	271	3. 7
	BANANA	77. 31	6/1/3. 75		0. 433	145	263	229	312	295	359	5. 8
	CHERRY	120. 40	6/4. 75+7/1. 60		0. 271	186	351	302	417	391	479	9. 0
	QUINCE	16. 84	3/4/1. 75		3. 240	48	79	71	94	90	107	0. 9
	RAISIN	34. 36	3/4/2. 50		1. 580	72	124	110	146	140	168	1. 9
	SULTANA	49. 48	4/3/3. 00		0. 893	98	172	152	204	194	234	3. 2
	WALNUT	77. 31	4/3/3. 75		0. 570	126	228	199	271	256	311	5. 1
	GRAPE	181. 60	30/7/2. 50		1. 960	221	434	368	515	480	592	12. 9
	LEMON	261. 50	30/7/3. 00		0. 136	265	545	456	647	600	745	18. 6
	LIME	356. 00	30/7/3. 50		0. 100	307	660	545	784	722	903	25. 4
	MANGO	431. 20	54/7/3. 00		0. 076	350	775	635	922	846	1062	33. 3
	OLIVE	586. 00	54/7/3. 50		0. 056	399	936	756	1115	1015	1285	41. 7
SC/GZ (Steel – Galv.)		9. 43	3/2. 00		18. 00	19	30	27	36	35	41	0. 5
		17. 82	3/2. 75		9. 67	27	44	40	53	51	61	0. 9
		21. 99	7/2. 00		7. 71	32	53	48	63	61	72	1. 1
		41. 58	7/2. 75		4. 14	44	76	67	90	86	103	2. 0
		58. 07	7/3. 25		2. 86	52	92	80	108	103	124	2. 9
		63. 55	7/3. 40		2. 61	55	97	85	115	109	132	3. 1

See Notes for 7.2.

Material	Conductor Name	Nom. CSA (mm²)	Strands (No. /Dia.)		DC Resistance @20ºC (Ω/km)	Current Rating (A)				Fault Rating 1s (kA)
						80ºC (ABC or CCT) Normal Distribution Lines		100ºC Emergency Rating		
			Metric (mm)	Imperial (inches)		Summer Day	Winter Night	Summer Day	Winter Night	
CCT (AAAC 1120)	CCT80	77. 30			0. 383	280	380	350	425	6. 8
	CCT120	124. 00			0. 239	370	510	475	582	11. 0
	CCT180	182. 80			0. 163	470	648	605	744	16. 2
LVABC	LVABC95 (4C)	380. 00			0. 320	234	320			8. 3
	2 x LVABC95 (4C)	760. 00			0. 160	468	640			16. 6
	LVABC150 (4C)	600. 00			0. 206	305	418			12. 9
	2x LVABC150 (4C)	1200. 00			0. 103	610	836			25. 1

See Notes for 7.2.

7.3 Mechanical properties

Material	Conductor Name	Stock Code	Strands (No. /Dia.) Metric (mm)	Strands (No. /Dia.) Imperial (inches)	CSA (mm2)	Nom. Cable Diameter (mm)	Nom. Breaking Load / UTS (kN)	Mass (kg/m)	Modulus of Elasticity (GPa)	Linear Expansion Coefficient (/ºC x 10-6)
AAC (1350)	LEO		7/2. 50		34. 36	7. 50	5. 75	0. 094	59	23
	LIBRA		7/3. 00		49. 48	9. 00	7. 91	0. 135	59	23
	MARS		7/3. 75		77. 31	11. 25	11. 90	0. 212	59	23
	MERCURY		7/4. 50		111. 30	13. 50	16. 80	0. 305	56	23
	MOON		7/4. 75		124. 00	14. 25	18. 8	0. 340	59	23
	NEPTUNE		19/3. 25		157. 60	16. 25	24. 70	0. 433	56	23
	PLUTO		19/3. 75		209. 80	18. 80	32. 3	0. 578	56	23
			19/4. 47	19/. 176	298. 16	22. 35	51. 30	0. 924	56	23
	TAURUS		19/4. 75		336. 70	23. 80	51. 30	0. 956	56	23
	TRITON		37/3. 75		408. 70	26. 30	62. 90	1. 130	56	23
	URANUS		61/3. 25		506. 00	29. 30	75. 20	1. 400	54	23
AAAC (1120)	CHLORINE		7/2. 50		34. 36	7. 50	8. 18	0. 094	124	23
	HYDROGEN		7/4. 50		111. 30	11. 25	24. 30	0. 304	56	23
	KRYPTON		19/3. 25		157. 60	16. 25	37. 40	0. 433	56	23
HDC (Hard Drawn Copper)			7/1. 75		16. 84	5. 25	6. 89	0. 151	124	17
			7/2. 00		21. 99	6. 00	9. 02	0. 197	124	17
			7/2. 75		41. 58	8. 25	16. 70	0. 373	124	17
			19/2. 00		59. 70	10. 00	23. 90	0. 538	124	17
			19/2. 56	19/. 101	98. 21	12. 83	39. 56	0. 887	124	17
			19/2. 75		112. 90	13. 80	44. 50	1. 020	124	17
			19/3. 00		134. 30	15. 00	52. 80	1. 210	124	17
			37/2. 11	37/. 083	129. 16	14. 76	52. 51	1. 170	124	17
			37/2. 75		219. 80	19. 30	83. 90	1. 990	124	17

Notes:

1. Conductors other than current preferred sizes are included for reference purposes.
2. Conductor data is generally in accordance with Australian Standards. Note that product from various manufacturers may differ slightly from the above data.

Material	Conductor Name	Stock Code	Strands (No. /Dia.)		CSA (mm2)	Nom. Cable Diameter (mm)	Nom. Breaking Load / UTS (kN)	Mass (kg/m)	Modulus of Elasticity (GPa)	Linear Expansion Coefficient (/ºC x 10-6)
			Metric (mm)	Imperial (inches)						
ACSR/GZ	ALMOND		6/1/2. 50		34. 36	7. 50	10. 50	0. 119	79	19. 3
	APPLE		6/1/3. 00		49. 50	9. 00	14. 90	0. 171	79	19. 3
	BANANA		6/1/3. 75		77. 31	11. 30	22. 70	0. 268	79	19. 3
	CHERRY		6/4. 75+7/1. 60		120. 40	14. 30	33. 20	0. 404	76	19. 9
	QUINCE		3/4/1. 75		16. 84	5. 30	12. 70	0. 095	139	19. 3
	RAISIN		3/4/2. 50		34. 36	7. 50	24. 40	0. 195	139	19. 3
	SULTANA		4/3/3. 00		49. 48	9. 00	28. 30	0. 243	122	15. 2
	WALNUT		4/3/3. 75		77. 31	11. 30	43. 90	0. 380	122	15. 2
	GRAPE		30/7/2. 50		181. 60	17. 50	63. 50	0. 677	80	18. 4
	LEMON		30/7/3. 00		261. 50	21. 00	90. 40	0. 973	80	18. 4
	LIME		30/7/3. 50		356. 00	24. 50	122. 00	1. 320	80	18. 4
	MANGO		54/7/3. 00		431. 20	27. 00	119. 00	1. 440	68	19. 9
	OLIVE		54/7/3. 50		586. 00	31. 50	159. 00	1. 960	68	19. 9
SC/GZ (Steel – Galv.)			3/2. 00		9. 43	4. 31	11. 70	0. 076	193	11. 5
			3/2. 75		17. 82	5. 93	22. 20	0. 139	193	11. 5
			7/2. 00		21. 99	6. 00	27. 40	0. 177	193	11. 5
			7/2. 75		41. 58	8. 25	51. 80	0. 326	193	11. 5
			7/3. 25		58. 07	9. 75	72. 30	0. 460	193	11. 5
			7/3. 40		63. 55	10. 2	103. 20	0. 162	193	11. 5
CCT (AAAC 1120 / 3. 4mm XLPE)	CCT80	144519	7/3. 75		77. 30	18. 65	17. 60	0. 450	65	23
	CCT120	147421	7/4. 75		124. 00	21. 65	27. 10	0. 640	65	23
	CCT180	176311	19/3. 50		182. 80	24. 90	41. 70	0. 870	65	23
LVABC (AAC / XLPE)	LVABC95 (4C)	67959	4/11. 4		380. 00	38. 40	53. 20	1. 35	56	23
	LVABC150 (4C)	148080	4/14. 2		600. 00	45. 60	84. 00	2. 02	56	23

Notes:

1. Conductors other than current preferred sizes are included for reference purposes.
2. Conductor data is generally in accordance with Australian Standards. Note that product from various manufacturers may differ slightly from the above data.

7.4 CCT design considerations

7.4.1 Poletop constructions

At intermediate (non-strain) poles, CCT should be installed on post insulators rather than standard pin insulators, which do not offer satisfactory lightning or electrical tracking performance and can lead to burn down of the CCT. Special polymer ties must be used to attach CCT to the insulators rather than standard metallic tie wire. Insulation is to remain in tact (no stripping) at the insulators.

At strain points, the insulation is stripped and bolted strain clamps fitted, along with insulating covers.

7.4.2 Water blocking

CCT is water-blocked, i. e. it has a polymer between the conductor strands to prevent migration of water along the conductor under the insulated exterior. Therefore the conductor does not require special jointing or terminating techniques, and may simply be bared at any point where a connection is required. Covers are available for parallel groove clamps, strain clamps and earthing points. These are by no means water-proof, but do help to preserve the integrity of the covering.

7.4.3 Lightning protection

CCT is more prone to lightning damage than bare conductor. This is because the insulation tends to fix the point of any arc that may develop as a result of a flashover, whereas on bare conductor the arc would move about along the conductor surface. This concentration of energy may cause the conductor to burn down. For this reason, it is essential that surge arresters or current-limiting arcing horns (CLAHs) be installed at regular intervals along covered conductor lines.

These are typically applied to intermediate poles adjacent to strain (termination) constructions, and also at every fourth pole or maximum of 200 – 250m. A downlead to a butt earth or stake earth is required at each set of CLAHs. In areas known to be prone to lightning strikes, e . exposed areas or ridges, it is recommended that CLAHs be installed at all intermediate poles.

Regular surge arresters, as found at transformers or underground cable terminations, may be considered to be part of this protection. (One advantage of CLAHs over regular surge arresters for lightning protection of CCT is that they are not permanently connected to the line and any failures do not initiate outages.)

7.4.4 Earthing points

Earthing points must be established at all points where it is envisaged that access permit earths or working earths will be required during future operations/maintenance/extension works. Such points would include either side of HV switching devices.

At earthing points, the insulation is removed for a length of 125mm and a cover fitted.

7.4.5 Stringing

Due to its high weight in comparison with bare conductors, CCT is generally strung at moderate tensions, typically not exceeding 10% UTS, and with spans usually less than 120m in length.

7.5 Engineering notes

7.5.1 Conductor/cable designations

Accurate Conductor Coding as per NS100 must be used. **Informative only** - Conductors may be referred to in various ways:

Code names which indicate conductor material, size and stranding. For example, *PLUTO* represents an aluminium conductor with 19 x 3. 75mm dia. strands, or *APPLE*, which refers to a conductor with 6 x 3. 00mm dia. aluminium strands and 1 x 3. 00mm dia. galvanized steel reinforcing strand. These codes provide a very concise way of designating conductors. Different families of codes indicate the general class of conductor, such as celestial names for metric AAC, fruit names for metric ACSR, animal names for imperial ACSR (e. g. *BEAR*), chemical elements for AAAC alloy 1120 (e. g. *CHLORINE*).

Stranding and material, e. g. *19/3.75 AAC* for *PLUTO* indicates 19 strands, each of 3.75mm diameter. *APPLE* may be described as *6/1/3 00 ACSR/GZ*. For imperial sizes, strand diameter may be expressed in inches (e. g. *7/.104 HDC*, which is equivalent to 7/2.64), or even as a wire gauge (*7/12 HDC*).

Nominal cross-sectional area, particularly for insulated cables, e. g. *CCT 80*, or *LVABC 150*. The numbers pertain to square millimetres for metric sizes.

7.5.2 Conductor materials

Copper conductors

In the early days of electrification, hard drawn copper (HDC) conductors were used widely. Although copper has excellent conductivity, it is expensive, and also very heavy. Thus the forces exerted upon supporting structures are very high.

Many older light gauge copper lines now suffer from corrosion, low current-carrying capacity and low fault current capacity.

Aluminium conductors

On a weight-for-weight basis, aluminium is more than twice as conductive as copper. Aluminium conductors are also less expensive than copper conductors of equivalent capacity. All Aluminium Conductor (AAC) is used for most bare distribution mains within Ausgrid. The metal used is known as alloy 1350, which is 99. 6% pure aluminium.

Some All Aluminium Alloy Conductor (AAAC) is used within the Ausgrid network, generally alloy 1120. This has greater strength than AAC and is suitable for tight stringing on long spans. However, the conductivity of AAAC is slightly inferior to AAC. AAAC can provide a useful alternative to ACSR for rural lines in coastal areas where corrosion due to salt pollution is a problem.

Aluminium has good resistance to corrosion in most environments, the one exception being in the vicinity of alkaline industrial pollution. Also, it is important that aluminium is kept clear of copper or copper salts/residue. When connecting copper to aluminium, bi-metal clamps are required. When replacing copper conductors with aluminium, it is usual practice to replace insulators.

Although aluminium oxidizes in a way that is self-passivating and prevents further corrosion, the oxide layer forms extremely rapidly and is not readily visible. When making an electrical connection, it is essential that the conductor be scratch-brushed first and immediately dipped in jointing compound; otherwise the connection will have high impedance and may burn out under fault current conditions.

Aluminium conductors can suffer from annealing when subjected to excessive heat, eg due to overloading or fires. Annealing weakens the conductor irreparably and causes excessive sag.

Since aluminium is a comparatively soft material, it can easily be abraded at the support points when subjected to aeolian (wind-induced) vibration. Consequently armour rods are fitted to tight-strung aluminium conductors at all intermediate structures.

Steel conductors

Although a very strong material, steel has poor conductivity compared with copper and aluminium. Thus, nowadays steel is mainly used as a reinforcing material, or with an aluminium coating on SWER lines.

Also, steel conductor is prone to corrosion in polluted or coastal environments as the galvanizing layer is eventually consumed.

ACSR conductors

These conductors have properties that lie between those of aluminum and those of steel, and therefore have moderate conductivity and moderate strength. They are particularly suited to rural areas where span lengths are long and electrical loading is light. Various ratios of steel to aluminium are used depending upon the application.

7.5.3 Insulated/covered cables

Insulated cables – ABC (Aerial Bundled Cable) and CCT (Covered Conductor - Thick) – are now widely used to improve network reliability due to their resistance to outages caused by vegetation or wildlife. They also offer improved safety in special situations, such as near boat ramps, loading docks, hang glider launch sites or in narrow easements. They can be used where reduced tree-trimming profiles are required. Clause 7.1 provides guidance on when insulated or bare conductors should be used.

Due to the additional weight and wind loading of the insulation, these conductors are heavier than bare conductors of equivalent capacity and consequently have reduced spanning capability. They are also more expensive than bare conductors.

The CCT used within Ausgrid has an insulation thickness of approximately 3.4mm. Since the conductor has no earthed screen, it should be treated as if it were bare for operational purposes.

Additional information regarding the design of CCT lines is presented in Clause 7.4.

7.5.4 Overhead earth wires

AAC, AAAC and ACSR conductors may be used for overhead earthwires above subtransmission lines for intercepting direct lightning strikes. OHEW conductor selected to match required lightning performance, fault level and fault clearing time. Ideally, outer layer strand size should not be much less than 3mm diameter so that strands are not severed by lighting strikes. Optical ground wires (OPGW) are designed for use as overhead earth wires incorporating optical fibres.

7.5.5 Mechanical properties

Nominal or Projected Diameter is important for determining wind force on the conductor. For a 7 strand bare conductor, overall projected diameter is three times the strand diameter. For a 19 strand conductor, overall projected diameter is five times the strand diameter. For a 37 strand conductor, overall projected diameter is seven times the strand diameter.

Cross-Sectional Area (CSA) is equal to the area of each strand times the number of strands. Conductor strength, weight and conductivity are all proportional to the CSA.

Mass affects the tension in the line. Heavier conductors need to be strung tighter than light conductors for equivalent sags and therefore apply more force to supporting poles. Aluminium conductors have a very low mass relative to their cross-sectional area.

Ultimate Tensile Strength (UTS) is also known as minimum/calculated/nominal breaking load. Steel conductors have very high strengths relative to their CSA.

Modulus of Elasticity is a measure of stress or load applied to a material to cause a given strain (deformation or stretch).

Coefficient of Linear Expansion is the rate at which a conductor expands in length as temperature increases. Aluminium has a higher expansion coefficient than copper or steel and so tends to sag more as it heats up.

7.5.6 Current ratings

The current rating of a power line is dependant upon a number of factors. These include:

- the resistance of the line and how much heat is generated
- the maximum temperature for which a line is designed to operate, a function of the material and available clearances
- how much heat the line absorbs from and dissipates to the surroundings.

Many older lines were designed for operation at temperatures in the range 55ºC to 65 ºC, and as a consequence their capacity is limited. However, conductors may be allowed to operate at higher temperatures provided that:

- clearances from ground and subcircuits are adequate, even with the increased sag
- no damage will be sustained by the line, eg annealing of conductors or plasticising of any insulation.

Line ratings are calculated by solving a heat balance equation:

$$P_L = P_F + P_R - P_S$$

where:

P_L Power loss in the conductor (W/m)

P_F Power loss due to forced convection (W/m)

P_R Power loss due to radiation (W/m)

P_S Power gain to solar radiation – incident and reflected from ground (W/m).

These heat flows, may be calculated as follows:

$$P_L = I^2 R_{20} (1+ \alpha(t_a + \theta - 20))$$

$$P_F = \pi \lambda_f \theta [A + B (\sin \psi)^n] [C (\mu D / v_f)^p]$$

$$P_R = \pi E_C s D ((t_a + \theta + 273)^4 - (t_a + 273)^4)$$

$$P_S = \alpha_s S D$$

where:

I current rating (A)

R_{20} a. c. resistance of conductor at 20°C (Ω/m)—slightly greater than d. c. resistance due to magnetic effect of steel core for ACSR (see Reference 23) and skin effect (see Reference 17 section 8)

α temperature coefficient of resistance (/°C), 0. 0036 for AAAC, 0. 00403 for AAC, 0. 0044 for steel

t_a ambient temperature (°C) — Ausgrid use 15°C for winter night, 35°C for summer day for bare conductors, 40°C for insulated conductors

θ allowable surface temperature rise (°C)

V wind velocity normal to conductor (m/s)

D conductor diameter (mm)

d outer layer strand diameter (mm)

π pi, 3. 141592

E_C emissivity of conductor – 0. 2 for new bright surface, 0. 9 for old/blackened/ insulated, Ausgrid use 0.2 for aluminium, 0.3 for copper

s Stefan-Boltzmann constant 5.67 x 10^{-8} (W/m^2)

α_s solar absorption coefficient – 0.6 for new bright surface, 0.9 for old or blackened conductor W/m^2) -Ausgrid use 0.6 for bare and 0.5 for insulated

S intensity of solar radiation (W/m^2) — Ausgrid use 1000 W/m^2 incl. ground reflectance

λ_f thermal conductivity of air film at conductor surface(W/m^2°C)

v_f kinematic viscosity of air film at conductor surface (m^2/s)

ψ angle of wind relative to conductor axis — Ausgrid assume wind is normal to conductor

μ wind velocity (m/s) — Ausgrid use 0. 5m/s

A, B, n constants dependant upon value of ψ as shown in table below

C, p constants dependant upon value of Reynolds Number as shown in table below

Angle of wind ψ	A	B	n
0° – 23°	0. 42	0. 68	1. 08
24° – 90°	0. 42	0. 58	0. 90

Surface Roughness d/2D	Reynolds number	c	p
≤0. 1	100 – 5,000	0. 57	0. 485
	5000 – 50,000	0. 094	0. 71
>0. 1	100 – 5,000	0. 57	0. 485
	5000 – 50,000	0. 051	0. 79

For additional information, see Clause 3.3, References 24, 34 and 35.

7.5.7 Fault current ratings

Fault current ratings may be calculated using the following material heating equation:

Temperature Rise = Energy dissipated / (Mass x Specific Heat)

The temperature rise must not be sufficient to cause annealing or permanent damage to the conductor or any insulation. Since energy dissipated depends upon the I^2R losses and the duration of the fault, an expression for the maximum fault current can be derived:

$$I_F(t) = ((T_{max} - T_a)\ m\ C / R\ t)^{1/2}$$

where:

$I_F(t)$ maximum allowable fault current (kA) for duration *t*

t duration of fault (s) – typically 1s

T_2 final maximum allowable conductor temperature (°C)—160°C for aluminium and ACSR, 200°C for copper, 400°C for steel, these temperatures corresponding to a 5% loss of strength through annealing over total fault clearing time over entire life of conductor, including recloses

T_1 initial/ambient temperature (°C), say 35°C

m conductor mass (kg/m)

C specific heat of conductor material (J/g°C) – 0. 9 for aluminium, 0. 5 for steel, 0. 4 for copper– strictly, not a constant

R conductor resistance (Ω/km) – strictly, not a constant

However, since resistance and specific heat are not constant but vary with temperature, a more sophisticated equation for determining maximum fault currents is presented in Reference 23 Annexure BB:

$$J^2 t = \frac{DC_{20}\left[1 + A_c\left(\frac{T_1 + T_2}{2} - 20\right)\right]}{A_r R} \ln\left[\frac{T_2 - 20 + \frac{1}{A_r}}{T_1 - 20 + \frac{1}{A_r}}\right]$$

where

A_r = temperature coefficient of resistance in °C^{-1}

R = resistivity in ohm. mm at 20°C

D = density in g/mm$^{3 \text{ or kg/cm3}}$

J = current density in A/mm^2

A_c = temperature coefficient of specific heat

Typical values of these parameters for various conductor materials are shown in the following table. For ACSR conductors, values may be calculated according to the ratio of aluminium to steel cross-sectional area.

Parameter	Units	AAC	AAAC/ 1120	HD copper	SC/GZ
Ar (at 20°C)	°C–1	0. 00403	0. 00390	0. 00381	0. 00440
R (at 20°C)	Ωmm	28. 3 × 10–6	29. 3 × 10–6	17. 77 × 10–6	190 × 10–6
D	g/mm3	2. 70 × 10–3	2. 70 × 10–3	8. 89 × 10–3	7. 8 × 10–3
C20	Jg–1°C–1	0. 9	0. 9	0. 4	0. 5
Ac	°C–1	4. 5 × 10–4	4. 5 × 10–4	2. 9 × 10–4	1. 0 × 10–4

Fault ratings for different durations may be related to the one second fault rating, $I_F(1)$, using the relationship:

$$I_F(t) = I_F(1) / \sqrt{t}$$

Thus, a 2s fault rating is equal to the 1s fault rating divided by √2.

7.5.8 Conductor ageing

Conductor properties change with age.

The conductor will lose strength over time as it anneals, depending upon its thermal operating history. If it has suffered overloading or a large number of fault currents, then the effect will be more pronounced.

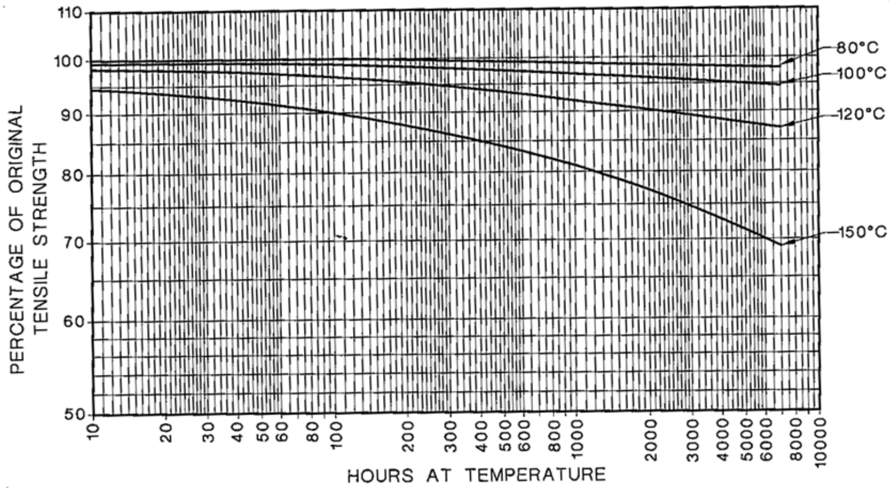


FIGURE D1 PERCENTAGE OF ORIGINAL TENSILE STRENGTH FOR ALLOY 1350 vs AGEING TIME

The conductor's absorptivity and emissivity will change as it loses its initial shine and discolours due to pollution or external corrosion.

The conductor will also suffer from fatigue, corrosion and creep to varying degrees, depending upon the material and environmental conditions. Creep is discussed further in Clause 8. 4.

7.5.9 Calculation of voltage drop

Voltage drop in a line can be calculated using Ohm's Law:

$$V = I\,Z$$

where:

V	Voltage drop (V)
I	Current (A)
Z	Cable/conductor impedance (Ω), a function of circuit length.

Note that impedance includes reactance, *X*, as well as the resistance, *R*.

$$Z = \sqrt{(R^2 + X^2)}$$

Also note that AC resistance is slightly higher than DC resistance due to the 'skin effect' (where current density is greater in the surface layers of a conductor than in its interior due to the self-inductance of the conductor) and the magnetic effect for steel or ACSR conductor (which leads to hysteresis and eddy currents, increasing the losses and the effective resistance).

Reactance includes inductive and capacitive effects, the latter being particularly relevant for insulated cables. The inductive reactance depends upon the height and phase spacing/configuration of the line.

8.0 CONDUCTOR STRINGING

8.1 Standard tensions and stringing table selection

Standard conductor stringing tensions have been developed by Ausgrid to enable line designers to determine sags and mechanical forces by reference to the standard tables. Designers with access to computer software for line design are not constrained to use standard tensions, but should endeavour to do so where practicable.

The tables in this section give sag and blowout for a range of span lengths, temperatures and ruling spans for each *class* of conductor. Note that there will be slight variations from conductor to conductor within a class, e. g. Mercury (7/4.50 AAC) will differ slightly from Pluto (19/3.75 AAC).

Apart from sags, wave sagging times (3 wave returns) and conductor tensions are also listed to assist construction crews that may use wave sagging or dynamometers to tension conductors to the required degree. Both initial (prior to creep) and final sags (after creep) are presented in the tables. The final sag values will primarily be of interest to designers.

Users may need to interpolate between tabulated values where the precise span length or ruling span is not available.

Several non-standard 'legacy' stringing tables have been included for use with existing lines.

Designers should select a stringing tension appropriate to the span length, as shown below. Note that the span lengths and ranges shown are *typical* for distribution lines and presented as a general guideline only. Span length limits will be influenced by the type of conductor/cable used, conductor fittings, structure strength, interphase spacing, line voltage and available ground clearance.

Stringing Tension (% UTS)1	Typical Span (m)		Typical Application
	Length	Range	
2	25	10 - 35	Short slack spans, service lines
6	65	30 - 90	Urban areas
10	100	50 - 125	Semi-rural areas, LVABC, CCT
12	100	50-140	Semi-rural areas, AAC, AAAC, ACSR, HDC, Steel
20	160	75 - 200	Rural areas, AAC, HDC
22. 5	210	100 - 260	Rural areas, ACSR Low Steel Content
	250	125 - 320	Rural areas, ACSR High Steel Content
22. 5	320	150 - 400	Rural areas, SC/GZ

[1] Tensions are given at a reference temperature of 5ºC. As temperature increases, actual conductor tensions reduce, and vice versa.

When selecting a stringing tension, designers should apply the following guidelines:

- Do not make lines unnecessarily tight - this increases the cost of structures and the number of stays required.
- Attempt to keep spans of similar length within a strain section where it is practical to do so, taking into account terrain, property boundaries etc. Through-termination constructions should be used to isolate any spans that are significantly shorter or longer than adjacent spans.
- Within any strain section, no span length should be more than double the ruling span, or less than half the ruling span. (Outside this ratio Ruling Span Assumption fails at higher conductor operating temperature and can cause excessive sag in longest span in tension section). In fact, on tight-strung lines, it is preferable that the longest span is not more than double the shortest span within any strain section. If this is not done, large forces can occur when the line is cold, damaging insulators and crossarms.
- Subcircuits should generally not be strung tighter than supercircuits (ADSS excepted).

8.2 Stringing table index and notes

8. 2. Sheet 1

Conductor Class	Stringing Tension		Ruling Span (m)	Sect. 8. 3 Sheet No.
	% UTS	Description		
AAC	2	Slack	20	1
			40	2
	6	Urban	40	3
			60	4
			80	5
			100	6
	12	Semi-Urban	50	7
			75	8
			100	9
			150	10
	20	Rural	100	11
			150	12
			200	13
			250	14
	8	Non-standard (Legacy)	50	15
			75	16
			100	17
	14	Non-standard (Legacy)	75	18
			100	19
			150	20
AAAC (1120)	2	Slack	20	21
			40	22
	6	Urban	40	23
			60	24
			80	25
			100	26
	12	Semi-Urban	50	27
			75	28
			100	29
			150	30

Conductor Class	Stringing Tension		Ruling Span (m)	Sect. 8. 3 Sheet No.
	% UTS	Description		
AAAC	20	Rural	100	31
			150	32
			200	33
			250	34
ACSR (Low Steel Content)	12	Semi-Urban	50	35
			75	36
			100	37
			150	38
	22. 5	Rural	100	39
			150	40
			200	41
			250	42
ACSR (High Steel Content)	12	Semi-Urban	50	43
			75	44
			100	45
			150	46
	22. 5	Rural	100	47
			150	48
			200	49
			250	50
LVABC	2	Slack	20	51
			40	52
	6	Urban	40	53
			60	54
			80	55
			100	56
	10	Semi-Urban	50	57
			75	58
			100	59

Conductor Class	Stringing Tension		Ruling Span (m)	Sect. 8. 3 Sheet No.
	% UTS	Description		
CCT	2	Slack	20	60
			40	61
	6	Urban	40	62
			60	63
			80	64
			100	65
	10	Semi-Urban	50	66
			75	67
			100	68
			150	69
HDC (Copper)	2	Slack	20	70
			40	71
	6	Urban	40	72
			60	73
			80	74
			100	75
	12	Semi-Urban	50	76
			75	77
			100	78
			150	79
	20	Rural	100	80
			150	81
			200	82
			250	83

8. 2 Sheet 2

Conductor Class	Stringing Tension		Ruling Span (m)	Sect. 8. 3 Sheet No.	Conductor Class	Stringing Tension		Ruling Span (m)	Sect. 8. 3 Sheet No.	Conductor Class	Stringing Tension		Ruling Span (m)	Sect. 8.3 Sheet No.
	% UTS	Description				% UTS	Description				% UTS	Description		
Steel	12	Semi-Urban	50	84	ADSS									
			75	85										
			100	86										
			150	87										
	22. 5	Rural	100	88										
			150	89										
			200	90										
			250	91										
Services	2	Slack	Single span	92										

General Notes Regarding Stringing Tables

1. Ensure that you are using the correct chart - correct conductor material type, correct stringing tension and suitable ruling span.
2. Ensure tight-strung conductors have proper anti-vibration protection and damping.
3. Initial sag is for construction—stringing new conductors. Final sag is after inelastic stretch (creep) and applies to conductors that have been in-service for some time.
4. Reference temperature for conductor stringing (% UTS) is 5ºC. Tension is for ‘no wind’ condition. Blow-out is calculated at 500Pa and 40ºC and includes allowance for conductor stretch.
5. Sag/tension tables were generated using TLPRO software.
6. Obsolete conductor types and sizes have been included for reference purposes to facilitate connection to or modification of the existing network. These are not intended for use on new lines.
7. Non-standard legacy charts have been included (AAC 8%UTS and 14%UTS) for integrating design with existing mains. These are not intended for use on new lines.

8.3 Stringing tables

AAC

8.3 Sheet 1 BARE AAC SLACK (2% UTS) 20m RULING SPAN

		SAG (m/ TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
10	Sag	0. 11	0. 11	0. 11	0. 11	0. 12	0. 12	0. 12	0. 12	0. 12	0. 12	0. 13	0. 13	0. 13	0. 13	0. 14	0. 16	0. 14
	3 Returns	1. 77	1. 78	1. 81	1. 82	1. 84	1. 85	1. 88	1. 88	1. 91	1. 91	1. 94	1. 94	1. 97	1. 97			
15	Sag	0. 24	0. 25	0. 25	0. 26	0. 26	0. 27	0. 27	0. 27	0. 28	0. 28	0. 29	0. 29	0. 30	0. 30	0. 33	0. 36	0. 29
	3 Returns	2. 67	2. 68	2. 73	2. 74	2. 78	2. 79	2. 83	2. 84	2. 88	2. 89	2. 92	2. 93	2. 96	2. 97			
20	Sag	0. 43	0. 44	0. 45	0. 46	0. 47	0. 47	0. 49	0. 49	0. 50	0. 51	0. 52	0. 52	0. 54	0. 54	0. 58	0. 65	0. 56
	3 Returns	3. 57	3. 58	3. 64	3. 66	3. 71	3. 73	3. 78	3. 79	3. 84	3. 86	3. 91	3. 92	3. 96	3. 98			
25	Sag	0. 70	0. 70	0. 73	0. 73	0. 76	0. 76	0. 78	0. 79	0. 81	0. 82	0. 84	0. 84	0. 86	0. 87	0. 94	1. 05	0. 88
	3 Returns	4. 52	4. 54	4. 62	4. 64	4. 71	4. 73	4. 79	4. 81	4. 87	4. 89	4. 95	4. 97	5. 02	5. 04			
30	Sag	1. 00	1. 01	1. 05	1. 05	1. 09	1. 10	1. 13	1. 13	1. 16	1. 17	1. 20	1. 21	1. 24	1. 25	1. 35	1. 50	1. 27
	3 Returns	5. 42	5. 45	5. 54	5. 56	5. 64	5. 66	5. 74	5. 76	5. 84	5. 86	5. 93	5. 95	6. 02	6. 04			
35	Sag	1. 36	1. 38	1. 42	1. 43	1. 48	1. 49	1. 53	1. 54	1. 58	1. 59	1. 63	1. 65	1. 68	1. 69	1. 83	2. 05	1. 58
	3 Returns	6. 32	6. 35	6. 45	6. 48	6. 58	6. 60	6. 70	6. 72	6. 81	6. 83	6. 92	6. 94	7. 02	7. 04			
40	Sag	1. 78	1. 80	1. 86	1. 87	1. 93	1. 94	2. 00	2. 01	2. 07	2. 08	2. 13	2. 15	2. 20	2. 21	2. 39	2. 67	2. 07
	3 Returns	7. 22	7. 25	7. 37	7. 40	7. 52	7. 54	7. 65	7. 68	7. 78	7. 80	7. 90	7. 93	8. 02	8. 04			
CONDUCTOR		TENSION (kN)																
MARS (7/3. 75)		0. 25	0. 24	0. 24	0. 23	0. 23	0. 22	0. 22	0. 21	0. 21	0. 20	0. 21	0. 20	0. 20	0. 19	0. 18	0. 16	
MERCURY (7/4. 50)		0. 36	0. 34	0. 34	0. 32	0. 33	0. 31	0. 31	0. 30	0. 30	0. 29	0. 29	0. 28	0. 28	0. 27	0. 25	0. 23	
NEPTUNE (19/3. 25)		0. 50	0. 49	0. 48	0. 47	0. 46	0. 45	0. 44	0. 44	0. 43	0. 42	0. 41	0. 41	0. 40	0. 40	0. 37	0. 33	
PLUTO (19/3. 75)		0. 64	0. 64	0. 61	0. 61	0. 59	0. 59	0. 57	0. 57	0. 55	0. 55	0. 54	0. 53	0. 52	0. 52	0. 48	0. 43	
TAURUS (19/4. 75)		1. 03	1. 02	0. 99	0. 98	0. 95	0. 94	0. 92	0. 91	0. 89	0. 88	0. 86	0. 85	0. 83	0. 83	0. 77	0. 69	
TRITON (37/3. 75)		1. 27	1. 24	1. 21	1. 19	1. 17	1. 15	1. 12	1. 11	1. 09	1. 07	1. 05	1. 04	1. 02	1. 01	0. 93	0. 83	
URANUS (61/3. 50)		1. 50	1. 50	1. 45	1. 44	1. 40	1. 39	1. 35	1. 34	1. 31	1. 30	1. 27	1. 27	1. 23	1. 23	1. 14	1. 03	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC:Nil

8.3 Sheet 2 BARE AAC SLACK (2% UTS) 40m RULING SPAN

SPAN LENGTH (m)	ELEMENT	SAG (m/ TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
20	Sag	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 43
	3 Returns	0. 88	0. 89	0. 89	0. 89	0. 89	0. 89	0. 90	0. 90	0. 90	0. 90	0. 91	0. 91	0. 91	0. 91			
25	Sag	0. 11	0. 11	0. 11	0. 11	0. 11	0. 11	0. 11	0. 11	0. 11	0. 11	0. 12	0. 12	0. 12	0. 12	0. 12	0. 13	0. 68
	3 Returns	1. 80	1. 80	1. 81	1. 81	1. 82	1. 82	1. 82	1. 83	1. 83	1. 84	1. 84	1. 84	1. 85	1. 85			
30	Sag	0. 25	0. 25	0. 25	0. 25	0. 26	0. 26	0. 26	0. 26	0. 26	0. 26	0. 26	0. 26	0. 27	0. 27	0. 27	0. 29	0. 98
	3 Returns	2. 71	2. 71	2. 72	2. 73	2. 74	2. 74	2. 75	2. 75	2. 76	2. 77	2. 78	2. 78	2. 79	2. 79			
35	Sag	0. 45	0. 45	0. 45	0. 45	0. 46	0. 46	0. 46	0. 46	0. 47	0. 47	0. 47	0. 47	0. 47	0. 48	0. 49	0. 51	1. 33
	3 Returns	3. 62	3. 63	3. 64	3. 64	3. 66	3. 66	3. 68	3. 68	3. 70	3. 70	3. 71	3. 72	3. 73	3. 73			
40	Sag	0. 72	0. 72	0. 73	0. 73	0. 73	0. 73	0. 74	0. 74	0. 75	0. 75	0. 76	0. 76	0. 76	0. 76	0. 79	0. 82	1. 74
	3 Returns	4. 59	4. 59	4. 61	4. 62	4. 64	4. 64	4. 66	4. 67	4. 68	4. 69	4. 71	4. 71	4. 73	4. 73			
45	Sag	0. 25	0. 25	0. 25	0. 25	0. 26	0. 26	0. 26	0. 26	0. 26	0. 26	0. 26	0. 26	0. 27	0. 27	0. 27	0. 29	2. 21
	3 Returns	2. 71	2. 71	2. 72	2. 73	2. 74	2. 74	2. 75	2. 75	2. 76	2. 77	2. 78	2. 78	2. 79	2. 79			
50	Sag	1. 40	1. 41	1. 42	1. 42	1. 43	1. 44	1. 45	1. 45	1. 46	1. 47	1. 48	1. 48	1. 49	1. 49	1. 54	1. 60	2. 72
	3 Returns	6. 41	6. 42	6. 45	6. 45	6. 48	6. 49	6. 51	6. 52	6. 54	6. 55	6. 58	6. 58	6. 61	6. 61			
CONDUCTOR		TENSION (kN)																
MARS (7/3. 75)		0. 24	0. 33	0. 24	0. 33	0. 23	0. 33	0. 23	0. 32	0. 23	0. 32	0. 23	0. 32	0. 22	0. 31	0. 21	0. 20	
MERCURY (7/4. 50)		0. 34	0. 33	0. 33	0. 33	0. 33	0. 33	0. 33	0. 32	0. 32	0. 32	0. 32	0. 32	0. 32	0. 32	0. 30	0. 29	
NEPTUNE (19/3. 25)		0. 49	0. 49	0. 48	0. 48	0. 48	0. 48	0. 47	0. 47	0. 47	0. 47	0. 46	0. 46	0. 46	0. 46	0. 44	0. 42	
PLUTO (19/3. 75)		0. 63	0. 63	0. 62	0. 62	0. 62	0. 61	0. 61	0. 61	0. 60	0. 60	0. 60	0. 60	0. 59	0. 59	0. 57	0. 55	
TAURUS (19/4. 75)		1. 01	1. 01	1. 00	1. 00	0. 99	0. 99	0. 98	0. 98	0. 97	0. 97	0. 96	0. 96	0. 95	0. 95	0. 92	0. 88	
TRITON (37/3. 75)		1. 23	1. 22	1. 22	1. 21	1. 21	1. 20	1. 19	1. 19	1. 18	1. 17	1. 17	1. 16	1. 16	1. 15	1. 12	1. 07	
URANUS (61/3. 50)		1. 48	1. 48	1. 47	1. 46	1. 45	1. 45	1. 44	1. 44	1. 42	1. 42	1. 41	1. 41	1. 40	1. 40	1. 36	1. 31	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC:Nil

8.3 Sheet 3 **BARE AAC** **URBAN (6% UTS)** **40m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
20	Sag	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 43
	3 Returns	0. 88	0. 89	0. 89	0. 89	0. 89	0. 89	0. 90	0. 90	0. 90	0. 90	0. 91	0. 91	0. 91	0. 91			
25	Sag	0. 11	0. 11	0. 11	0. 11	0. 11	0. 11	0. 11	0. 11	0. 11	0. 11	0. 12	0. 12	0. 12	0. 12	0. 12	0. 13	0. 68
	3 Returns	1. 80	1. 80	1. 81	1. 81	1. 82	1. 82	1. 82	1. 83	1. 83	1. 84	1. 84	1. 84	1. 85	1. 85			
30	Sag	0. 25	0. 25	0. 25	0. 25	0. 26	0. 26	0. 26	0. 26	0. 26	0. 26	0. 26	0. 26	0. 27	0. 27	0. 27	0. 29	0. 98
	3 Returns	2. 71	2. 71	2. 72	2. 73	2. 74	2. 74	2. 75	2. 75	2. 76	2. 77	2. 78	2. 78	2. 79	2. 79			
35	Sag	0. 45	0. 45	0. 45	0. 45	0. 46	0. 46	0. 46	0. 46	0. 47	0. 47	0. 47	0. 47	0. 47	0. 48	0. 49	0. 51	1. 33
	3 Returns	3. 62	3. 63	3. 64	3. 64	3. 66	3. 66	3. 68	3. 68	3. 70	3. 70	3. 71	3. 72	3. 73	3. 73			
40	Sag	0. 72	0. 72	0. 73	0. 73	0. 73	0. 73	0. 74	0. 74	0. 75	0. 75	0. 76	0. 76	0. 76	0. 76	0. 79	0. 82	1. 74
	3 Returns	4. 59	4. 59	4. 61	4. 62	4. 64	4. 64	4. 66	4. 67	4. 68	4. 69	4. 71	4. 71	4. 73	4. 73			
45	Sag	0. 25	0. 25	0. 25	0. 25	0. 26	0. 26	0. 26	0. 26	0. 26	0. 26	0. 26	0. 26	0. 27	0. 27	0. 27	0. 29	2. 21
	3 Returns	2. 71	2. 71	2. 72	2. 73	2. 74	2. 74	2. 75	2. 75	2. 76	2. 77	2. 78	2. 78	2. 79	2. 79			
50	Sag	1. 40	1. 41	1. 42	1. 42	1. 43	1. 44	1. 45	1. 45	1. 46	1. 47	1. 48	1. 48	1. 49	1. 49	1. 54	1. 60	2. 72
	3 Returns	6. 41	6. 42	6. 45	6. 45	6. 48	6. 49	6. 51	6. 52	6. 54	6. 55	6. 58	6. 58	6. 61	6. 61			
CONDUCTOR		TENSION (kN)																
MARS (7/3. 75)		0. 24	0. 33	0. 24	0. 33	0. 23	0. 33	0. 23	0. 32	0. 23	0. 32	0. 23	0. 32	0. 22	0. 31	0. 21	0. 20	
MERCURY (7/4. 50)		0. 34	0. 33	0. 33	0. 33	0. 33	0. 33	0. 33	0. 32	0. 32	0. 32	0. 32	0. 32	0. 32	0. 32	0. 30	0. 29	
NEPTUNE (19/3. 25)		0. 49	0. 49	0. 48	0. 48	0. 48	0. 48	0. 47	0. 47	0. 47	0. 47	0. 46	0. 46	0. 46	0. 46	0. 44	0. 42	
PLUTO (19/3. 75)		0. 63	0. 63	0. 62	0. 62	0. 62	0. 61	0. 61	0. 61	0. 60	0. 60	0. 60	0. 60	0. 59	0. 59	0. 57	0. 55	
TAURUS (19/4. 75)		1. 01	1. 01	1. 00	1. 00	0. 99	0. 99	0. 98	0. 98	0. 97	0. 97	0. 96	0. 96	0. 95	0. 95	0. 92	0. 88	
TRITON (37/3. 75)		1. 23	1. 22	1. 22	1. 21	1. 21	1. 20	1. 19	1. 19	1. 18	1. 17	1. 17	1. 16	1. 16	1. 15	1. 12	1. 07	
URANUS (61/3. 50)		1. 48	1. 48	1. 47	1. 46	1. 45	1. 45	1. 44	1. 44	1. 42	1. 42	1. 41	1. 41	1. 40	1. 40	1. 36	1. 31	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:4ºC

8.3 Sheet 4 **BARE AAC** **URBAN (6% UTS)** **60m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
30	Sag	0. 32	0. 33	0. 33	0. 34	0. 34	0. 36	0. 36	0. 37	0. 37	0. 38	0. 38	0. 39	0. 39	0. 40	0. 44	0. 49	0. 40
	3 Returns	3. 04	3. 11	3. 11	3. 18	3. 17	3. 23	3. 23	3. 29	3. 29	3. 35	3. 34	3. 40	3. 39	3. 45			
40	Sag	0. 56	0. 59	0. 59	0. 61	0. 61	0. 64	0. 63	0. 66	0. 66	0. 68	0. 68	0. 70	0. 70	0. 72	0. 78	0. 87	0. 71
	3 Returns	4. 06	4. 16	4. 15	4. 24	4. 23	4. 32	4. 31	4. 39	4. 39	4. 47	4. 46	4. 54	4. 53	4. 60			
50	Sag	0. 88	0. 92	0. 92	0. 96	0. 96	0. 99	0. 99	1. 03	1. 03	1. 06	1. 06	1. 10	1. 09	1. 13	1. 22	1. 36	1. 11
	3 Returns	5. 08	5. 20	5. 19	5. 30	5. 30	5. 40	5. 39	5. 50	5. 49	5. 59	5. 58	5. 67	5. 66	5. 76			
60	Sag	1. 27	1. 33	1. 32	1. 38	1. 38	1. 43	1. 43	1. 48	1. 48	1. 53	1. 53	1. 58	1. 58	1. 63	1. 76	1. 96	1. 59
	3 Returns	6. 10	6. 24	6. 23	6. 37	6. 36	6. 49	6. 48	6. 60	6. 59	6. 71	6. 70	6. 81	6. 80	6. 91			
70	Sag	1. 74	1. 82	1. 82	1. 90	1. 89	1. 97	1. 97	2. 04	2. 03	2. 11	2. 10	2. 17	2. 17	2. 24	2. 42	2. 70	2. 17
	3 Returns	7. 15	7. 32	7. 31	7. 46	7. 45	7. 60	7. 59	7. 74	7. 72	7. 86	7. 85	7. 98	7. 97	8. 10			
80	Sag	2. 28	2. 38	2. 38	2. 48	2. 47	2. 57	2. 57	2. 66	2. 66	2. 75	2. 74	2. 84	2. 83	2. 92	3. 16	3. 53	2. 83
	3 Returns	8. 17	8. 36	8. 35	8. 53	8. 52	8. 69	8. 67	8. 84	8. 83	8. 98	8. 97	9. 12	9. 11	9. 26			
90	Sag	2. 88	3. 01	3. 01	3. 14	3. 13	3. 26	3. 25	3. 37	3. 36	3. 48	3. 47	3. 59	3. 58	3. 70	4. 00	4. 47	3. 59
	3 Returns	9. 19	9. 40	9. 39	9. 59	9. 58	9. 77	9. 76	9. 94	9. 93	10. 10	10. 09	10. 26	10. 24	10. 41			
100	Sag	3. 56	3. 72	3. 71	3. 87	3. 86	4. 02	4. 01	4. 16	4. 15	4. 30	4. 29	4. 44	4. 42	4. 57	4. 94	5. 52	4. 43
	3 Returns	10. 21	10. 44	10. 43	10. 65	10. 64	10. 85	10. 84	11. 04	11. 03	11. 23	11. 21	11. 40	11. 38	11. 57			
CONDUCTOR		TENSION (kN)																
MARS (7/3. 75)		0. 78	0. 71	0. 74	0. 68	0. 71	0. 66	0. 68	0. 63	0. 66	0. 61	0. 63	0. 59	0. 61	0. 58	0. 53	0. 47	
MERCURY (7/4. 50)		1. 11	1. 01	1. 06	0. 97	1. 01	0. 93	0. 97	0. 90	0. 94	0. 87	0. 90	0. 85	0. 87	0. 82	0. 76	0. 68	
NEPTUNE (19/3. 25)		1. 54	1. 48	1. 48	1. 42	1. 42	1. 36	1. 36	1. 31	1. 31	1. 27	1. 27	1. 23	1. 23	1. 19	1. 10	0. 98	
PLUTO (19/3. 75)		1. 99	1. 91	1. 91	1. 83	1. 84	1. 77	1. 77	1. 70	1. 71	1. 65	1. 66	1. 60	1. 61	1. 55	1. 44	1. 29	
TAURUS (19/4. 75)		3. 21	3. 07	3. 07	2. 95	2. 95	2. 84	2. 85	2. 74	2. 75	2. 65	2. 66	2. 57	2. 58	2. 50	2. 31	2. 07	
TRITON (37/3. 75)		3. 94	3. 72	3. 77	3. 57	3. 62	3. 44	3. 49	3. 32	3. 37	3. 22	3. 26	3. 12	3. 16	3. 03	2. 80	2. 51	
URANUS (61/3. 50)		4. 60	4. 49	4. 42	4. 33	4. 26	4. 18	4. 12	4. 04	3. 99	3. 92	3. 87	3. 80	3. 77	3. 70	3. 43	3. 09	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:5ºC

8.3 Sheet 5 **BARE AAC** **URBAN (6% UTS)** **80m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
40	Sag	0. 57	0. 59	0. 59	0. 60	0. 60	0. 62	0. 62	0. 63	0. 63	0. 64	0. 64	0. 66	0. 65	0. 67	0. 69	0. 76	0. 64
	3 Returns	4. 10	4. 16	4. 15	4. 21	4. 20	4. 26	4. 25	4. 30	4. 29	4. 35	4. 34	4. 39	4. 38	4. 43			
50	Sag	0. 90	0. 92	0. 92	0. 95	0. 94	0. 97	0. 96	0. 99	0. 98	1. 01	1. 00	1. 03	1. 02	1. 05	1. 10	1. 19	1. 00
	3 Returns	5. 13	5. 21	5. 20	5. 27	5. 26	5. 33	5. 32	5. 38	5. 37	5. 44	5. 43	5. 49	5. 48	5. 54			
60	Sag	1. 29	1. 33	1. 33	1. 36	1. 36	1. 39	1. 39	1. 42	1. 42	1. 45	1. 45	1. 48	1. 48	1. 51	1. 59	1. 72	1. 45
	3 Returns	6. 16	6. 25	6. 24	6. 32	6. 31	6. 39	6. 38	6. 46	6. 45	6. 53	6. 52	6. 59	6. 58	6. 66			
70	Sag	1. 76	1. 81	1. 81	1. 86	1. 85	1. 90	1. 89	1. 94	1. 93	1. 98	1. 97	2. 02	2. 01	2. 06	2. 17	2. 35	1. 97
	3 Returns	7. 19	7. 29	7. 28	7. 38	7. 37	7. 46	7. 45	7. 54	7. 53	7. 62	7. 61	7. 70	7. 68	7. 77			
80	Sag	2. 32	2. 39	2. 38	2. 45	2. 44	2. 50	2. 49	2. 56	2. 55	2. 61	2. 60	2. 66	2. 65	2. 71	2. 86	3. 09	2. 57
	3 Returns	8. 25	8. 37	8. 35	8. 47	8. 45	8. 56	8. 55	8. 66	8. 64	8. 75	8. 73	8. 83	8. 82	8. 92			
90	Sag	2. 94	3. 02	3. 01	3. 10	3. 08	3. 16	3. 15	3. 23	3. 22	3. 30	3. 29	3. 37	3. 35	3. 43	3. 62	3. 91	3. 26
	3 Returns	9. 28	9. 42	9. 40	9. 53	9. 51	9. 63	9. 61	9. 73	9. 72	9. 83	9. 82	9. 93	9. 91	10. 03			
100	Sag	3. 63	3. 73	3. 72	3. 82	3. 81	3. 91	3. 89	3. 99	3. 98	4. 07	4. 06	4. 16	4. 14	4. 24	4. 47	4. 83	4. 02
	3 Returns	10. 31	10. 46	10. 44	10. 58	10. 56	10. 70	10. 68	10. 81	10. 79	10. 92	10. 90	11. 03	11. 01	11. 14			
110	Sag	4. 39	4. 52	4. 50	4. 62	4. 61	4. 73	4. 71	4. 83	4. 81	4. 93	4. 91	5. 03	5. 01	5. 13	5. 41	5. 84	4. 87
	3 Returns	11. 34	11. 50	11. 48	11. 64	11. 62	11. 77	11. 75	11. 89	11. 87	12. 02	11. 99	12. 13	12. 11	12. 25			
CONDUCTOR		TENSION (kN)																
MARS (7/3. 75)		0. 75	0. 71	0. 73	0. 69	0. 71	0. 68	0. 69	0. 66	0. 68	0. 65	0. 66	0. 64	0. 65	0. 62	0. 59	0. 54	
MERCURY (7/4. 50)		1. 06	1. 01	1. 03	0. 98	1. 01	0. 96	0. 98	0. 94	0. 96	0. 92	0. 94	0. 90	0. 92	0. 89	0. 84	0. 78	
NEPTUNE (19/3. 25)		1. 52	1. 47	1. 48	1. 44	1. 44	1. 40	1. 41	1. 37	1. 38	1. 34	1. 35	1. 32	1. 32	1. 29	1. 22	1. 13	
PLUTO (19/3. 75)		1. 95	1. 90	1. 91	1. 86	1. 86	1. 82	1. 82	1. 78	1. 79	1. 74	1. 75	1. 71	1. 71	1. 68	1. 59	1. 47	
TAURUS (19/4. 75)		3. 14	3. 06	3. 07	2. 99	3. 00	2. 92	2. 93	2. 86	2. 87	2. 80	2. 81	2. 75	2. 76	2. 69	2. 56	2. 36	
TRITON (37/3. 75)		3. 83	3. 71	3. 74	3. 62	3. 65	3. 54	3. 57	3. 47	3. 50	3. 40	3. 43	3. 33	3. 36	3. 27	3. 10	2. 87	
URANUS (61/3. 50)		4. 54	4. 48	4. 44	4. 38	4. 35	4. 29	4. 26	4. 21	4. 18	4. 12	4. 10	4. 05	4. 03	3. 98	3. 78	3. 51	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC:5ºC

8.3 Sheet 6 **BARE AAC** **URBAN (6% UTS)** **100m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s) — Temperature 5ºC INITIAL	5ºC FINAL	10ºC INITIAL	10ºC FINAL	15ºC INITIAL	15ºC FINAL	20ºC INITIAL	20ºC FINAL	25ºC INITIAL	25ºC FINAL	30ºC INITIAL	30ºC FINAL	35ºC INITIAL	35ºC FINAL	50ºC FINAL	75ºC FINAL	BLOWOUT (m)
50	Sag	0. 91	0. 93	0. 92	0. 94	0. 94	0. 96	0. 95	0. 97	0. 97	0. 98	0. 98	1. 00	0. 99	1. 01	1. 05	1. 11	0. 34
	3 Returns	5. 17	5. 22	5. 21	5. 26	5. 25	5. 29	5. 29	5. 33	5. 32	5. 37	5. 36	5. 41	5. 40	5. 44			
60	Sag	1. 31	1. 34	1. 33	1. 36	1. 35	1. 38	1. 37	1. 40	1. 39	1. 42	1. 41	1. 44	1. 43	1. 45	1. 51	1. 60	0. 61
	3 Returns	6. 20	6. 26	6. 25	6. 31	6. 30	6. 36	6. 35	6. 40	6. 39	6. 45	6. 44	6. 49	6. 48	6. 53			
70	Sag	1. 79	1. 82	1. 82	1. 85	1. 84	1. 88	1. 87	1. 90	1. 90	1. 93	1. 92	1. 96	1. 95	1. 98	2. 06	2. 18	0. 95
	3 Returns	7. 24	7. 31	7. 30	7. 36	7. 35	7. 42	7. 41	7. 47	7. 46	7. 52	7. 51	7. 57	7. 56	7. 62			
80	Sag	2. 34	2. 38	2. 37	2. 42	2. 41	2. 45	2. 45	2. 49	2. 48	2. 52	2. 51	2. 56	2. 55	2. 59	2. 69	2. 85	1. 37
	3 Returns	8. 28	8. 36	8. 34	8. 42	8. 41	8. 48	8. 47	8. 54	8. 53	8. 60	8. 59	8. 66	8. 65	8. 72			
90	Sag	2. 98	3. 04	3. 03	3. 08	3. 07	3. 13	3. 12	3. 17	3. 16	3. 22	3. 21	3. 26	3. 25	3. 30	3. 43	3. 63	1. 86
	3 Returns	9. 35	9. 43	9. 42	9. 51	9. 49	9. 58	9. 56	9. 64	9. 63	9. 71	9. 70	9. 78	9. 76	9. 84			
100	Sag	3. 68	3. 75	3. 74	3. 81	3. 79	3. 86	3. 85	3. 92	3. 91	3. 97	3. 96	4. 03	4. 01	4. 08	4. 24	4. 49	2. 44
	3 Returns	10. 38	10. 48	10. 46	10. 56	10. 54	10. 64	10. 62	10. 71	10. 70	10. 79	10. 77	10. 86	10. 84	10. 93			
110	Sag	4. 45	4. 54	4. 52	4. 61	4. 59	4. 67	4. 66	4. 74	4. 73	4. 81	4. 79	4. 87	4. 86	4. 94	5. 13	5. 43	3. 08
	3 Returns	11. 42	11. 53	11. 51	11. 61	11. 60	11. 70	11. 68	11. 78	11. 76	11. 86	11. 85	11. 95	11. 93	12. 02			
120	Sag	5. 30	5. 40	5. 38	5. 48	5. 46	5. 56	5. 55	5. 64	5. 63	5. 72	5. 70	5. 80	5. 78	5. 88	6. 10	6. 46	3. 81
	3 Returns	12. 46	12. 57	12. 55	12. 67	12. 65	12. 76	12. 74	12. 85	12. 83	12. 94	12. 92	13. 03	13. 01	13. 12			

CONDUCTOR	TENSION (kN) 5ºC INITIAL	5ºC FINAL	10ºC INITIAL	10ºC FINAL	15ºC INITIAL	15ºC FINAL	20ºC INITIAL	20ºC FINAL	25ºC INITIAL	25ºC FINAL	30ºC INITIAL	30ºC FINAL	35ºC INITIAL	35ºC FINAL	50ºC FINAL	75ºC FINAL	
MARS (7/3. 75)	0. 73	0. 71	0. 72	0. 70	0. 71	0. 69	0. 70	0. 68	0. 69	0. 67	0. 68	0. 66	0. 67	0. 65	0. 62	0. 59	
MERCURY (7/4. 50)	1. 04	1. 00	1. 02	0. 99	1. 00	0. 97	0. 99	0. 96	0. 97	0. 95	0. 96	0. 93	0. 95	0. 92	0. 89	0. 84	
NEPTUNE (19/3. 25)	1. 50	1. 47	1. 47	1. 44	1. 45	1. 42	1. 43	1. 40	1. 41	1. 38	1. 39	1. 36	1. 37	1. 34	1. 29	1. 22	
PLUTO (19/3. 75)	1. 93	1. 89	1. 90	1. 86	1. 87	1. 84	1. 84	1. 81	1. 82	1. 79	1. 79	1. 76	1. 77	1. 74	1. 68	1. 58	
TAURUS (19/4. 75)	3. 10	3. 04	3. 05	3. 00	3. 01	2. 95	2. 96	2. 91	2. 92	2. 87	2. 88	2. 83	2. 84	2. 80	2. 69	2. 54	
TRITON (37/3. 75)	3. 77	3. 69	3. 72	3. 64	3. 66	3. 58	3. 61	3. 53	3. 55	3. 48	3. 50	3. 44	3. 46	3. 39	3. 27	3. 09	
URANUS (61/3. 50)	4. 50	4. 46	4. 44	4. 40	4. 38	4. 34	4. 32	4. 28	4. 26	4. 22	4. 21	4. 17	4. 15	4. 12	3. 90	3. 76	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:5ºC

8.3 Sheet 7 BARE AAC SEMI-URBAN (12% UTS) 50m RULING SPAN

		SAG (m)) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0. 31	0. 46	0. 36	0. 53	0. 42	0. 60	0. 48	0. 67	0. 55	0. 74	0. 61	0. 80	0. 68	0. 85	1. 01	1. 24	0. 90
	3 Returns	3. 02	3. 69	3. 26	3. 96	3. 51	4. 21	3. 76	4. 44	4. 01	4. 65	4. 24	4. 83	4. 46	5. 01			
60	Sag	0. 45	0. 67	0. 52	0. 77	0. 60	0. 87	0. 70	0. 97	0. 79	1. 06	0. 88	1. 15	0. 98	1. 23	1. 46	1. 79	1. 30
	3 Returns	3. 63	4. 43	3. 91	4. 75	4. 21	5. 05	4. 52	5. 33	4. 81	5. 58	5. 09	5. 80	5. 35	6. 01			
70	Sag	0. 61	0. 91	0. 71	1. 05	0. 82	1. 19	0. 95	1. 32	1. 08	1. 44	1. 20	1. 56	1. 33	1. 68	1. 99	2. 44	1. 77
	3 Returns	4. 23	5. 17	4. 56	5. 55	4. 92	5. 90	5. 27	6. 22	5. 62	6. 51	5. 94	6. 77	6. 25	7. 02			
80	Sag	0. 80	1. 20	0. 93	1. 38	1. 08	1. 56	1. 25	1. 74	1. 42	1. 90	1. 59	2. 06	1. 75	2. 21	2. 62	3. 21	2. 32
	3 Returns	4. 86	5. 93	5. 24	6. 37	5. 64	6. 77	6. 05	7. 14	6. 45	7. 47	6. 82	7. 77	7. 17	8. 05			
90	Sag	1. 02	1. 52	1. 18	1. 75	1. 37	1. 98	1. 58	2. 20	1. 79	2. 41	2. 01	2. 61	2. 22	2. 80	3. 32	4. 07	2. 93
	3 Returns	5. 46	6. 67	5. 89	7. 16	6. 34	7. 61	6. 80	8. 03	7. 25	8. 40	7. 67	8. 74	8. 06	9. 06			
100	Sag	1. 26	1. 87	1. 46	2. 16	1. 69	2. 44	1. 95	2. 71	2. 21	2. 97	2. 48	3. 22	2. 74	3. 45	4. 10	5. 02	3. 62
	3 Returns	6. 07	7. 41	6. 54	7. 95	7. 05	8. 46	7. 56	8. 92	8. 06	9. 33	8. 52	9. 71	8. 96	10. 06			
CONDUCTOR		TENSION (kN)																
MARS (7/3. 75)		2. 12	1. 43	1. 79	1. 23	1. 53	1. 08	1. 32	0. 97	1. 15	0. 89	1. 03	0. 82	0. 93	0. 76	0. 64	0. 52	
MERCURY (7/4. 50)		3. 12	2. 03	2. 65	1. 75	2. 25	1. 54	1. 93	1. 39	1. 69	1. 26	1. 50	1. 17	1. 36	1. 09	0. 91	0. 75	
NEPTUNE (19/3. 25)		4. 07	2. 96	3. 50	2. 56	3. 02	2. 25	2. 63	2. 02	2. 32	1. 83	2. 09	1. 69	1. 90	1. 57	1. 32	1. 07	
PLUTO (19/3. 75)		5. 70	3. 83	4. 91	3. 32	4. 23	2. 94	3. 68	2. 64	3. 24	2. 41	2. 89	2. 23	2. 62	2. 08	1. 75	1. 43	
TAURUS (19/4. 75)		9. 19	6. 15	7. 90	5. 33	6. 80	4. 70	5. 90	4. 23	5. 19	3. 85	4. 63	3. 56	4. 19	3. 31	2. 79	2. 28	
TRITON (37/3. 75)		10. 26	7. 46	8. 84	6. 48	7. 65	5. 73	6. 68	5. 15	5. 92	4. 70	5. 32	4. 33	4. 84	4. 03	3. 39	2. 77	
URANUS (61/3. 50)		11. 35	9. 02	9. 88	7. 86	8. 66	6. 97	7. 67	6. 29	6. 88	5. 75	6. 25	5. 32	5. 74	4. 96	4. 19	3. 34	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:14ºC

8.3 Sheet 8 **BARE AAC** **SEMI-URBAN (12% UTS)** **75m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																
SPAN LENGTH (m)	ELEMENT	Temperature																BLOWOUT (m)
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0.34	0.46	0.38	0.50	0.42	0.54	0.45	0.58	0.49	0.61	0.53	0.65	0.56	0.68	0.77	0.91	0.70
	3 Returns	3.17	3.69	3.33	3.84	3.50	3.99	3.65	4.12	3.80	4.24	3.94	4.36	4.07	4.47			
60	Sag	0.49	0.67	0.55	0.72	0.60	0.78	0.66	0.83	0.71	0.88	0.76	0.93	0.81	0.97	1.10	1.29	1.01
	3 Returns	3.81	4.43	4.01	4.61	4.20	4.78	4.39	4.93	4.56	5.08	4.72	5.22	4.88	5.35			
70	Sag	0.67	0.91	0.74	0.99	0.82	1.06	0.89	1.13	0.97	1.20	1.04	1.27	1.11	1.33	1.51	1.78	1.38
	3 Returns	4.44	5.17	4.67	5.38	4.90	5.58	5.12	5.77	5.33	5.94	5.52	6.10	5.71	6.26			
80	Sag	0.88	1.20	0.98	1.30	1.08	1.40	1.18	1.49	1.27	1.58	1.37	1.67	1.46	1.76	1.99	2.34	1.80
	3 Returns	5.09	5.93	5.36	6.18	5.63	6.41	5.88	6.62	6.11	6.82	6.34	7.01	6.55	7.18			
90	Sag	1.12	1.52	1.24	1.65	1.36	1.77	1.49	1.89	1.61	2.01	1.73	2.12	1.85	2.22	2.52	2.97	2.28
	3 Returns	5.73	6.67	6.03	6.95	6.33	7.21	6.61	7.45	6.88	7.67	7.13	7.88	7.36	8.08			
100	Sag	1.38	1.87	1.53	2.03	1.68	2.19	1.84	2.33	1.99	2.47	2.14	2.61	2.28	2.74	3.11	3.66	2.82
	3 Returns	6.36	7.41	6.70	7.72	7.03	8.01	7.34	8.27	7.64	8.52	7.92	8.75	8.18	8.97			
110	Sag	1.67	2.27	1.85	2.46	2.04	2.64	2.22	2.82	2.41	2.99	2.59	3.16	2.76	3.32	3.77	4.43	3.41
	3 Returns	7.00	8.15	7.37	8.49	7.73	8.81	8.08	9.10	8.40	9.37	8.71	9.63	9.00	9.87			
120	Sag	1.99	2.70	2.20	2.92	2.42	3.15	2.64	3.36	2.86	3.56	3.08	3.76	3.28	3.95	4.48	5.27	4.06
	3 Returns	7.63	8.89	8.04	9.26	8.43	9.61	8.81	9.92	9.16	10.22	9.50	10.50	9.81	10.76			
130	Sag	2.33	3.16	2.58	3.43	2.84	3.69	3.10	3.94	3.36	4.18	3.61	4.41	3.85	4.64	5.26	6.19	4.76
	3 Returns	8.27	9.63	8.71	10.03	9.13	10.41	9.54	10.75	9.93	11.07	10.29	11.37	10.63	11.66			
140	Sag	2.71	3.67	3.00	3.98	3.30	4.27	3.60	4.55	3.89	4.83	4.18	5.09	4.45	5.35	6.06	7.12	5.52
	3 Returns	8.92	10.37	9.39	10.80	9.84	11.19	10.27	11.56	10.68	11.90	11.06	12.22	11.43	12.52			
150	Sag	3.10	4.21	3.44	4.57	3.79	4.92	4.13	5.25	4.47	5.57	4.81	5.88	5.13	6.18	7.01	8.25	6.34
	3 Returns	9.54	11.11	10.05	11.58	10.54	12.00	11.01	12.40	11.45	12.77	11.87	13.12	12.27	13.45			
CONDUCTOR		TENSION (kN)																
MARS (7/3.75)		1.89	1.43	1.69	1.31	1.53	1.21	1.40	1.14	1.29	1.07	1.20	1.01	1.12	0.96	0.84	0.72	
MERCURY (7/4.50)		2.72	2.02	2.44	1.86	2.21	1.73	2.02	1.62	1.86	1.52	1.73	1.44	1.62	1.37	1.21	1.03	
NEPTUNE (19/3.25)		3.91	2.96	3.53	2.72	3.20	2.52	2.93	2.35	2.70	2.21	2.51	2.09	2.35	1.98	1.74	1.48	
PLUTO (19/3.75)		5.19	3.82	4.68	3.52	4.25	3.28	3.90	3.07	3.60	2.89	3.35	2.74	3.14	2.61	2.30	1.96	
TAURUS (19/4.75)		8.38	6.15	7.55	5.66	6.85	5.26	6.27	4.92	5.78	4.63	5.37	4.39	5.03	4.17	3.62	3.12	
TRITON (37/3.75)		9.42	7.45	8.53	6.87	7.79	6.38	7.17	5.97	6.65	5.63	6.21	5.33	5.84	5.07	4.46	3.80	
URANUS (61/3.50)		10.82	9.01	9.89	8.33	9.12	7.76	8.46	7.28	7.90	6.88	7.42	6.53	7.01	6.22	5.49	4.69	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC:17ºC

8.3 Sheet 9 **BARE AAC** **SEMI-URBAN (12% UTS)** **100m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0.38	0.46	0.40	0.49	0.43	0.51	0.45	0.54	0.48	0.56	0.50	0.58	0.52	0.60	0.66	0.75	0.61
	3 Returns	3.33	3.69	3.44	3.79	3.54	3.88	3.64	3.96	3.74	4.05	3.83	4.12	3.91	4.20			
60	Sag	0.54	0.67	0.58	0.70	0.62	0.74	0.65	0.77	0.69	0.80	0.72	0.84	0.75	0.87	0.95	1.08	0.87
	3 Returns	3.99	4.43	4.13	4.55	4.25	4.66	4.37	4.76	4.49	4.86	4.60	4.95	4.70	5.04			
70	Sag	0.74	0.91	0.79	0.96	0.84	1.01	0.89	1.05	0.93	1.10	0.98	1.14	1.03	1.18	1.30	1.47	1.19
	3 Returns	4.66	5.17	4.82	5.31	4.96	5.43	5.10	5.56	5.24	5.67	5.36	5.78	5.49	5.88			
80	Sag	0.97	1.19	1.03	1.25	1.10	1.32	1.16	1.37	1.22	1.43	1.28	1.49	1.34	1.54	1.69	1.93	1.55
	3 Returns	5.33	5.91	5.50	6.07	5.67	6.21	5.84	6.35	5.99	6.48	6.13	6.61	6.27	6.72			
90	Sag	1.22	1.51	1.31	1.59	1.39	1.67	1.47	1.74	1.55	1.81	1.62	1.88	1.70	1.95	2.15	2.44	1.97
	3 Returns	5.99	6.65	6.19	6.83	6.38	6.99	6.57	7.15	6.74	7.29	6.90	7.43	7.06	7.57			
100	Sag	1.52	1.88	1.62	1.97	1.73	2.07	1.83	2.16	1.92	2.25	2.02	2.34	2.11	2.43	2.67	3.03	2.43
	3 Returns	6.68	7.42	6.90	7.61	7.12	7.79	7.32	7.97	7.51	8.13	7.69	8.29	7.87	8.43			
110	Sag	1.84	2.27	1.97	2.39	2.09	2.50	2.21	2.62	2.33	2.73	2.44	2.83	2.55	2.93	3.23	3.67	2.94
	3 Returns	7.35	8.16	7.59	8.37	7.83	8.57	8.05	8.76	8.26	8.94	8.46	9.11	8.65	9.28			
120	Sag	2.19	2.70	2.34	2.84	2.48	2.98	2.63	3.11	2.77	3.24	2.90	3.37	3.04	3.49	3.84	4.37	3.50
	3 Returns	8.02	8.90	8.28	9.13	8.54	9.35	8.78	9.56	9.01	9.75	9.23	9.94	9.44	10.12			
130	Sag	2.57	3.17	2.74	3.34	2.92	3.50	3.08	3.65	3.25	3.81	3.41	3.95	3.56	4.10	4.51	5.13	4.11
	3 Returns	8.68	9.64	8.97	9.89	9.25	10.13	9.51	10.35	9.76	10.56	10.00	10.77	10.22	10.96			
140	Sag	2.98	3.67	3.18	3.87	3.38	4.06	3.58	4.24	3.77	4.41	3.95	4.59	4.13	4.75	5.23	5.95	4.76
	3 Returns	9.35	10.38	9.66	10.65	9.96	10.91	10.24	11.15	10.51	11.38	10.76	11.59	11.01	11.80			
150	Sag	3.42	4.22	3.65	4.44	3.88	4.66	4.11	4.86	4.32	5.07	4.54	5.26	4.74	5.46	6.00	6.83	5.47
	3 Returns	10.02	11.12	10.35	11.41	10.67	11.68	10.97	11.94	11.26	12.19	11.53	12.42	11.79	12.65			
CONDUCTOR		TENSION (kN)																
MARS (7/3.75)		1.72	1.42	1.60	1.35	1.51	1.28	1.42	1.23	1.35	1.18	1.29	1.13	1.23	1.09	0.90	0.87	
MERCURY (7/4.50)		2.45	2.02	2.29	1.92	2.15	1.83	2.03	1.75	1.93	1.68	1.84	1.61	1.76	1.56	1.41	1.24	
NEPTUNE (19/3.25)		3.64	2.96	3.40	2.80	3.19	2.66	3.01	2.54	2.85	2.44	2.71	2.34	2.59	2.25	2.04	1.79	
PLUTO (19/3.75)		4.70	3.82	4.41	3.63	4.15	3.46	3.92	3.31	3.72	3.18	3.55	3.06	3.40	2.95	2.69	2.36	
TAURUS (19/4.75)		7.60	6.14	7.11	5.83	6.68	5.55	6.31	5.31	5.99	5.09	5.70	4.90	5.45	4.73	4.30	3.77	
TRITON (37/3.75)		8.73	7.44	8.20	7.07	7.74	6.74	7.33	6.44	6.98	6.18	6.67	5.95	6.39	5.74	5.21	4.58	
URANUS (61/3.50)		10.24	9.00	9.68	8.56	9.18	8.18	8.74	7.84	8.35	7.54	8.01	7.26	7.69	7.02	6.40	5.64	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC: 18ºC

8.3 Sheet 10 BARE AAC SEMI-URBAN (12% UTS) 150m RULING SPAN

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
75	Sag	0. 95	1. 05	0. 98	1. 08	1. 00	1. 10	1. 03	1. 13	1. 06	1. 15	1. 08	1. 18	1. 11	1. 20	1. 27	1. 38	1. 17
	3 Returns	5. 27	5. 55	5. 35	5. 62	5. 43	5. 69	5. 50	5. 76	5. 57	5. 82	5. 64	5. 88	5. 70	5. 94			
80	Sag	1. 08	1. 20	1. 11	1. 23	1. 14	1. 26	1. 17	1. 29	1. 20	1. 31	1. 23	1. 34	1. 26	1. 37	1. 45	1. 57	1. 33
	3 Returns	5. 63	5. 92	5. 71	6. 00	5. 79	6. 07	5. 87	6. 14	5. 94	6. 21	6. 01	6. 27	6. 09	6. 34			
90	Sag	1. 37	1. 51	1. 41	1. 55	1. 45	1. 59	1. 49	1. 63	1. 52	1. 66	1. 56	1. 70	1. 60	1. 73	1. 84	1. 99	1. 68
	3 Returns	6. 33	6. 67	6. 42	6. 75	6. 51	6. 83	6. 60	6. 91	6. 69	6. 99	6. 77	7. 06	6. 85	7. 13			
100	Sag	1. 69	1. 87	1. 74	1. 92	1. 79	1. 96	1. 83	2. 01	1. 88	2. 05	1. 93	2. 10	1. 97	2. 14	2. 27	2. 46	2. 07
	3 Returns	7. 04	7. 41	7. 14	7. 50	7. 24	7. 59	7. 34	7. 68	7. 43	7. 76	7. 52	7. 85	7. 61	7. 93			
110	Sag	2. 04	2. 26	2. 10	2. 32	2. 16	2. 38	2. 22	2. 43	2. 28	2. 49	2. 33	2. 54	2. 39	2. 59	2. 74	2. 98	2. 51
	3 Returns	7. 74	8. 15	7. 85	8. 25	7. 96	8. 35	8. 07	8. 45	8. 17	8. 54	8. 27	8. 63	8. 37	8. 72			
120	Sag	2. 44	2. 71	2. 52	2. 78	2. 59	2. 85	2. 66	2. 91	2. 73	2. 98	2. 79	3. 04	2. 86	3. 10	3. 28	3. 57	2. 99
	3 Returns	8. 47	8. 92	8. 59	9. 03	8. 71	9. 14	8. 83	9. 24	8. 94	9. 34	9. 05	9. 44	9. 16	9. 54			
130	Sag	2. 87	3. 18	2. 95	3. 26	3. 04	3. 34	3. 12	3. 42	3. 20	3. 49	3. 28	3. 57	3. 35	3. 64	3. 85	4. 19	3. 51
	3 Returns	9. 17	9. 66	9. 31	9. 78	9. 44	9. 90	9. 56	10. 01	9. 69	10. 12	9. 80	10. 23	9. 92	10. 33			
140	Sag	3. 32	3. 69	3. 42	3. 78	3. 52	3. 87	3. 62	3. 96	3. 71	4. 05	3. 80	4. 14	3. 89	4. 22	4. 47	4. 86	4. 07
	3 Returns	9. 88	10. 40	10. 02	10. 53	10. 16	10. 66	10. 30	10. 78	10. 43	10. 90	10. 56	11. 01	10. 68	11. 13			
150	Sag	3. 82	4. 23	3. 93	4. 34	4. 04	4. 45	4. 15	4. 55	4. 26	4. 65	4. 36	4. 75	4. 47	4. 85	5. 13	5. 57	4. 67
	3 Returns	10. 58	11. 14	10. 74	11. 28	10. 89	11. 42	11. 03	11. 55	11. 17	11. 68	11. 31	11. 80	11. 44	11. 92			
CONDUCTOR		TENSION (kN)																
MARS (7/3. 75)		2. 21	2. 02	2. 14	1. 96	2. 08	1. 92	2. 03	1. 87	1. 98	1. 83	1. 93	1. 79	1. 88	1. 75	1. 66	1. 52	
MERCURY (7/4. 50)		1. 56	1. 42	1. 52	1. 38	1. 47	1. 35	1. 43	1. 32	1. 40	1. 29	1. 36	1. 26	1. 33	1. 23	1. 16	1. 07	
NEPTUNE (19/3. 25)		3. 29	2. 95	3. 19	2. 87	3. 09	2. 80	3. 00	2. 73	2. 92	2. 67	2. 85	2. 61	2. 78	2. 55	2. 40	2. 20	
PLUTO (19/3. 75)		4. 22	3. 80	4. 10	3. 71	3. 98	3. 62	3. 88	3. 54	3. 78	3. 46	3. 69	3. 39	3. 61	3. 32	3. 14	2. 89	
TAURUS (19/4. 75)		6. 80	6. 12	6. 60	5. 96	6. 41	5. 82	6. 24	5. 69	6. 08	5. 56	5. 93	5. 44	5. 79	5. 33	5. 03	4. 63	
TRITON (37/3. 75)		8. 03	7. 42	7. 81	7. 23	7. 60	7. 06	7. 40	6. 90	7. 22	6. 74	7. 05	6. 60	6. 89	6. 46	6. 10	5. 61	
URANUS (61/3. 50)		9. 59	8. 96	9. 34	8. 75	9. 11	8. 55	8. 89	8. 37	8. 69	8. 19	8. 49	8. 03	8. 31	7. 87	7. 45	6. 87	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC: 19ºC

8.3 Sheet 11 **BARE AAC** **RURAL (20% UTS)** **100m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
60	Sag	0. 25	0. 40	0. 27	0. 44	0. 29	0. 48	0. 32	0. 52	0. 35	0. 56	0. 39	0. 60	0. 42	0. 64	0. 74	0. 90	0. 72
	3 Returns	2. 69	3. 43	2. 81	3. 60	2. 93	3. 76	3. 07	3. 91	3. 21	4. 06	3. 36	4. 19	3. 51	4. 32			
80	Sag	0. 44	0. 71	0. 48	0. 79	0. 52	0. 86	0. 57	0. 93	0. 63	1. 00	0. 69	1. 07	0. 75	1. 13	1. 32	1. 60	1. 27
	3 Returns	3. 59	4. 58	3. 74	4. 80	3. 91	5. 02	4. 10	5. 22	4. 29	5. 41	4. 49	5. 60	4. 69	5. 77			
100	Sag	0. 68	1. 12	0. 75	1. 23	0. 82	1. 34	0. 89	1. 45	0. 98	1. 56	1. 07	1. 67	1. 17	1. 77	2. 07	2. 50	1. 99
	3 Returns	4. 48	5. 72	4. 68	6. 00	4. 89	6. 27	5. 12	6. 53	5. 36	6. 77	5. 61	7. 00	5. 86	7. 21			
120	Sag	0. 99	1. 61	1. 07	1. 77	1. 17	1. 93	1. 29	2. 09	1. 41	2. 25	1. 55	2. 41	1. 69	2. 56	2. 98	3. 60	2. 87
	3 Returns	5. 38	6. 87	5. 62	7. 21	5. 87	7. 53	6. 15	7. 84	6. 44	8. 13	6. 74	8. 40	7. 04	8. 66			
140	Sag	1. 34	2. 19	1. 46	2. 41	1. 60	2. 63	1. 75	2. 85	1. 92	3. 06	2. 11	3. 28	2. 30	3. 48	4. 06	4. 91	3. 90
	3 Returns	6. 28	8. 02	6. 55	8. 41	6. 85	8. 79	7. 17	9. 14	7. 51	9. 48	7. 86	9. 80	8. 21	10. 10			
160	Sag	1. 76	2. 86	1. 91	3. 15	2. 09	3. 44	2. 29	3. 72	2. 51	4. 01	2. 75	4. 28	3. 00	4. 55	5. 30	6. 42	5. 10
	3 Returns	7. 18	9. 16	7. 49	9. 61	7. 83	10. 04	8. 20	10. 45	8. 59	10. 84	8. 98	11. 20	9. 39	11. 55			
180	Sag	2. 23	3. 63	2. 43	4. 00	2. 66	4. 37	2. 91	4. 73	3. 19	5. 09	3. 49	5. 44	3. 81	5. 78	6. 74	8. 15	6. 46
	3 Returns	8. 09	10. 33	8. 44	10. 83	8. 83	11. 32	9. 24	11. 78	9. 68	12. 22	10. 13	12. 63	10. 58	13. 01			
200	Sag	2. 75	4. 49	3. 00	4. 94	3. 28	5. 39	3. 59	5. 84	3. 94	6. 28	4. 31	6. 71	4. 71	7. 13	8. 32	10. 07	7. 97
	3 Returns	8. 99	11. 47	9. 38	12. 03	9. 81	12. 57	10. 27	13. 09	10. 75	13. 57	11. 25	14. 03	11. 75	14. 46			
CONDUCTOR		TENSION (kN)																
MARS (7/3. 75)		3. 45	2. 38	3. 14	2. 15	2. 85	1. 97	2. 58	1. 81	2. 35	1. 68	2. 14	1. 57	1. 97	1. 47	1. 26	1. 04	
MERCURY (7/4. 50)		5. 08	3. 38	4. 62	3. 06	4. 19	2. 80	3. 80	2. 58	3. 45	2. 39	3. 15	2. 24	2. 89	2. 10	1. 80	1. 49	
NEPTUNE (19/3. 25)		7. 63	4. 94	6. 99	4. 47	6. 39	4. 08	5. 83	3. 76	5. 31	3. 48	4. 85	3. 25	4. 45	3. 05	2. 61	2. 15	
PLUTO (19/3. 75)		10. 38	6. 37	9. 53	5. 79	8. 72	5. 31	7. 96	4. 90	7. 26	4. 55	6. 07	4. 26	5. 59	4. 01	3. 44	2. 85	
TAURUS (19/4. 75)		16. 74	10. 25	15. 37	9. 30	14. 05	8. 51	12. 82	7. 85	11. 68	7. 29	10. 66	6. 82	9. 76	6. 41	5. 50	4. 54	
TRITON (37/3. 75)		18. 15	12. 43	16. 67	11. 30	15. 26	10. 36	13. 95	9. 56	12. 77	8. 88	11. 71	8. 31	10. 78	7. 82	7. 00	5. 52	
URANUS (61/3. 50)		21. 62	15. 02	19. 94	13. 69	18. 36	12. 58	16. 88	11. 63	15. 54	10. 83	14. 32	10. 15	13. 25	9. 57	8. 22	6. 82	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:27ºC

8.3 Sheet 12 BARE AAC RURAL (20% UTS) 150m RULING SPAN

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
80	Sag	0. 49	0. 71	0. 53	0. 76	0. 56	0. 80	0. 60	0. 83	0. 64	0. 87	0. 68	0. 91	0. 71	0. 95	1. 05	1. 21	1. 02
	3 Returns	3. 80	4. 58	3. 93	4. 71	4. 06	4. 83	4. 20	4. 95	4. 33	5. 06	4. 46	5. 17	4. 58	5. 27			
100	Sag	0. 77	1. 12	0. 82	1. 18	0. 88	1. 24	0. 94	1. 31	1. 00	1. 37	1. 06	1. 42	1. 12	1. 48	1. 65	1. 89	1. 60
	3 Returns	4. 76	5. 73	4. 92	5. 89	5. 08	6. 04	5. 25	6. 19	5. 41	6. 33	5. 57	6. 47	5. 73	6. 59			
120	Sag	1. 11	1. 61	1. 19	1. 70	1. 27	1. 79	1. 35	1. 88	1. 44	1. 97	1. 52	2. 05	1. 61	2. 13	2. 37	2. 73	2. 30
	3 Returns	5. 71	6. 87	5. 90	7. 07	6. 10	7. 25	6. 30	7. 43	6. 50	7. 60	6. 69	7. 76	6. 87	7. 91			
140	Sag	1. 51	2. 19	1. 62	2. 32	1. 73	2. 44	1. 84	2. 56	1. 96	2. 68	2. 07	2. 79	2. 19	2. 91	3. 23	3. 72	3. 13
	3 Returns	6. 66	8. 02	6. 89	8. 25	7. 12	8. 46	7. 35	8. 67	7. 58	8. 87	7. 80	9. 06	8. 02	9. 24			
160	Sag	1. 97	2. 86	2. 11	3. 03	2. 26	3. 19	2. 41	3. 35	2. 56	3. 50	2. 71	3. 65	2. 86	3. 80	4. 22	4. 86	4. 09
	3 Returns	7. 61	9. 17	7. 87	9. 43	8. 14	9. 67	8. 40	9. 91	8. 66	10. 14	8. 92	10. 35	9. 17	10. 56			
180	Sag	2. 51	3. 64	2. 68	3. 85	2. 87	4. 05	3. 06	4. 25	3. 25	4. 45	3. 44	4. 64	3. 64	4. 83	5. 36	6. 18	5. 18
	3 Returns	8. 58	10. 33	8. 87	10. 62	9. 17	10. 90	9. 47	11. 17	9. 76	11. 42	10. 05	11. 66	10. 33	11. 90			
200	Sag	3. 10	4. 49	3. 31	4. 75	3. 54	5. 00	3. 77	5. 25	4. 01	5. 49	4. 25	5. 73	4. 49	5. 96	6. 62	7. 63	6. 40
	3 Returns	9. 53	11. 48	9. 86	11. 80	10. 19	12. 11	10. 52	12. 41	10. 85	12. 69	11. 17	12. 96	11. 48	13. 22			
220	Sag	3. 75	5. 44	4. 01	5. 75	4. 28	6. 05	4. 56	6. 35	4. 85	6. 64	5. 14	6. 93	5. 44	7. 21	8. 01	9. 23	7. 74
	3 Returns	10. 48	12. 63	10. 84	12. 98	11. 21	13. 32	11. 57	13. 65	11. 93	13. 96	12. 28	14. 25	12. 63	14. 54			
240	Sag	4. 46	6. 47	4. 77	6. 84	5. 09	7. 20	5. 43	7. 56	5. 77	7. 91	6. 12	8. 25	6. 47	8. 58	9. 53	10. 99	9. 21
	3 Returns	11. 44	13. 77	11. 83	14. 16	12. 23	14. 53	12. 62	14. 89	13. 02	15. 23	13. 40	15. 55	13. 77	15. 86			
260	Sag	5. 23	7. 59	5. 60	8. 03	5. 98	8. 46	6. 37	8. 87	6. 78	9. 28	7. 18	9. 68	7. 59	10. 07	11. 19	12. 90	10. 82
	3 Returns	12. 39	14. 92	12. 81	15. 34	13. 24	15. 74	13. 67	16. 13	14. 10	16. 49	14. 52	16. 84	14. 92	17. 18			
CONDUCTOR		TENSION (kN)																
MARS (7/3. 75)		3. 50	2. 37	3. 26	2. 24	3. 04	2. 12	2. 84	2. 02	2. 66	1. 93	2. 50	1. 85	2. 36	1. 77	1. 59	1. 38	
MERCURY (7/4. 50)		4. 53	3. 37	4. 23	3. 18	3. 96	3. 02	3. 71	2. 87	3. 49	2. 75	3. 30	2. 63	3. 13	2. 53	2. 27	1. 97	
NEPTUNE (19/3. 25)		7. 05	4. 93	6. 59	4. 65	6. 16	4. 40	5. 77	4. 19	5. 42	3. 99	5. 11	3. 82	4. 83	3. 67	3. 29	2. 84	
PLUTO (19/3. 75)		9. 23	6. 37	8. 63	6. 02	8. 08	5. 72	7. 58	5. 45	7. 13	5. 21	6. 73	5. 00	6. 37	4. 80	4. 32	3. 76	
TAURUS (19/4. 75)		14. 93	10. 24	13. 94	9. 67	13. 04	9. 18	12. 22	8. 74	11. 49	8. 35	10. 83	8. 00	10. 24	7. 69	6. 91	6. 00	
TRITON (37/3. 75)		16. 60	12. 41	15. 56	11. 74	14. 62	11. 14	13. 77	10. 61	13. 00	10. 14	12. 30	9. 72	11. 68	9. 34	8. 40	7. 29	
URANUS (61/3. 50)		19. 95	15. 00	18. 79	14. 22	17. 72	13. 53	16. 74	12. 91	15. 86	12. 36	15. 06	11. 86	14. 33	11. 41	10. 30	8. 99	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC:30ºC

8.3 Sheet 13 **BARE AAC** **RURAL (20% UTS)** **200m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																
SPAN LENGTH (m)	ELEMENT	Temperature																BLOWOUT (m)
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
100	Sag	0. 87	1. 12	0. 91	1. 16	0. 95	1. 20	0. 99	1. 24	1. 03	1. 28	1. 07	1. 31	1. 11	1. 35	1. 45	1. 62	1. 40
	3 Returns	5. 05	5. 73	5. 16	5. 83	5. 28	5. 93	5. 39	6. 03	5. 50	6. 12	5. 60	6. 21	5. 70	6. 29			
120	Sag	1. 25	1. 61	1. 31	1. 67	1. 37	1. 73	1. 42	1. 78	1. 48	1. 84	1. 54	1. 89	1. 60	1. 94	2. 10	2. 33	2. 02
	3 Returns	6. 06	6. 88	6. 20	7. 00	6. 33	7. 12	6. 47	7. 23	6. 60	7. 34	6. 72	7. 45	6. 84	7. 55			
140	Sag	1. 70	2. 20	1. 78	2. 28	1. 86	2. 35	1. 94	2. 43	2. 02	2. 50	2. 10	2. 58	2. 17	2. 65	2. 85	3. 17	2. 75
	3 Returns	7. 07	8. 03	7. 23	8. 17	7. 39	8. 31	7. 55	8. 44	7. 70	8. 57	7. 84	8. 69	7. 99	8. 81			
160	Sag	2. 22	2. 87	2. 33	2. 97	2. 43	3. 07	2. 53	3. 17	2. 64	3. 27	2. 74	3. 37	2. 84	3. 46	3. 73	4. 15	3. 59
	3 Returns	8. 08	9. 18	8. 26	9. 34	8. 45	9. 50	8. 63	9. 65	8. 80	9. 80	8. 97	9. 94	9. 13	10. 07			
180	Sag	2. 82	3. 65	2. 96	3. 78	3. 09	3. 91	3. 22	4. 03	3. 35	4. 15	3. 48	4. 28	3. 62	4. 39	4. 74	5. 27	4. 55
	3 Returns	9. 10	10. 34	9. 31	10. 53	9. 52	10. 70	9. 72	10. 87	9. 92	11. 04	10. 10	11. 20	10. 30	11. 35			
200	Sag	3. 49	4. 50	3. 65	4. 66	3. 81	4. 82	3. 98	4. 98	4. 14	5. 13	4. 30	5. 28	4. 45	5. 43	5. 85	6. 51	5. 62
	3 Returns	10. 11	11. 49	10. 35	11. 70	10. 58	11. 89	10. 80	12. 08	11. 02	12. 27	11. 23	12. 44	11. 43	12. 61			
220	Sag	4. 22	5. 45	4. 42	5. 64	4. 61	5. 83	4. 81	6. 02	5. 01	6. 21	5. 20	6. 39	5. 39	6. 57	7. 08	7. 88	6. 80
	3 Returns	11. 12	12. 64	11. 38	12. 86	11. 63	13. 08	11. 88	13. 29	12. 12	13. 49	12. 35	13. 69	12. 57	13. 87			
240	Sag	5. 02	6. 48	5. 26	6. 71	5. 49	6. 94	5. 72	7. 17	5. 96	7. 39	6. 19	7. 60	6. 41	7. 81	8. 43	9. 38	8. 09
	3 Returns	12. 14	13. 79	12. 42	14. 03	12. 69	14. 27	12. 96	14. 50	13. 22	14. 72	13. 47	14. 93	13. 72	15. 14			
260	Sag	5. 89	7. 61	6. 17	7. 88	6. 44	8. 15	6. 72	8. 41	6. 99	8. 67	7. 26	8. 92	7. 53	9. 17	9. 89	11. 01	9. 50
	3 Returns	13. 15	14. 93	13. 45	15. 20	13. 75	15. 46	14. 04	15. 70	14. 32	15. 94	14. 59	16. 17	14. 86	16. 40			
280	Sag	6. 83	8. 82	7. 15	9. 14	7. 47	9. 45	7. 79	9. 76	8. 11	10. 06	8. 42	10. 35	8. 73	10. 64	11. 47	12. 77	11. 02
	3 Returns	14. 16	16. 08	14. 48	16. 37	14. 80	16. 65	15. 12	16. 91	15. 42	17. 17	15. 71	17. 42	16. 00	17. 66			
CONDUCTOR		TENSION (kN)																
MARS (7/3. 75)		2. 88	2. 37	2. 75	2. 29	2. 63	2. 21	2. 53	2. 14	2. 43	2. 07	2. 34	2. 01	2. 26	1. 95	1. 81	1. 62	
MERCURY (7/4. 50)		4. 27	3. 37	4. 08	3. 25	3. 90	3. 14	3. 74	3. 04	3. 59	2. 94	3. 45	2. 86	3. 33	2. 78	2. 58	2. 31	
NEPTUNE (19/3. 25)		6. 38	4. 92	6. 08	4. 74	5. 81	4. 58	5. 56	4. 42	5. 34	4. 29	5. 13	4. 16	4. 94	4. 04	3. 73	3. 34	
PLUTO (19/3. 75)		8. 20	6. 35	7. 83	6. 13	7. 50	5. 93	7. 19	5. 75	6. 91	5. 58	6. 66	5. 42	6. 42	5. 27	4. 89	4. 40	
TAURUS (19/4. 75)		13. 26	10. 22	12. 66	9. 86	12. 10	9. 53	11. 60	9. 23	11. 14	8. 95	10. 72	8. 69	10. 33	8. 45	7. 83	7. 03	
TRITON (37/3. 75)		15. 18	12. 39	14. 53	11. 96	13. 94	11. 56	13. 40	11. 19	12. 90	10. 86	12. 45	10. 55	12. 03	10. 26	9. 51	8. 54	
URANUS (61/3. 50)		18. 31	14. 98	17. 58	14. 48	16. 91	14. 02	16. 29	13. 59	15. 72	13. 20	15. 19	12. 84	14. 70	12. 50	11. 62	10. 47	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:31ºC

8.3 Sheet 14 BARE AAC RURAL (20% UTS) 250m RULING SPAN

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
100	Sag	0. 94	1. 12	0. 97	1. 15	1. 00	1. 18	1. 03	1. 20	1. 06	1. 23	1. 08	1. 25	1. 11	1. 28	1. 35	1. 47	1. 29
	3 Returns	5. 26	5. 74	5. 34	5. 81	5. 42	5. 88	5. 49	5. 94	5. 57	6. 00	5. 64	6. 07	5. 71	6. 13			
120	Sag	1. 36	1. 62	1. 40	1. 66	1. 44	1. 69	1. 48	1. 73	1. 52	1. 77	1. 56	1. 81	1. 60	1. 84	1. 95	2. 11	1. 86
	3 Returns	6. 31	6. 89	6. 41	6. 97	6. 50	7. 05	6. 59	7. 13	6. 68	7. 21	6. 77	7. 28	6. 85	7. 35			
140	Sag	1. 85	2. 20	1. 90	2. 25	1. 96	2. 31	2. 02	2. 36	2. 07	2. 41	2. 12	2. 46	2. 18	2. 51	2. 65	2. 88	2. 53
	3 Returns	7. 36	8. 04	7. 48	8. 13	7. 59	8. 23	7. 69	8. 32	7. 79	8. 41	7. 89	8. 50	7. 99	8. 58			
160	Sag	2. 41	2. 88	2. 49	2. 95	2. 56	3. 01	2. 63	3. 08	2. 70	3. 15	2. 77	3. 21	2. 84	3. 28	3. 47	3. 76	3. 31
	3 Returns	8. 42	9. 19	8. 55	9. 30	8. 67	9. 41	8. 79	9. 51	8. 91	9. 61	9. 02	9. 71	9. 14	9. 81			
180	Sag	3. 07	3. 65	3. 16	3. 74	3. 25	3. 83	3. 35	3. 92	3. 44	4. 00	3. 53	4. 08	3. 61	4. 17	4. 40	4. 78	4. 19
	3 Returns	9. 49	10. 35	9. 63	10. 48	9. 77	10. 60	9. 91	10. 72	10. 04	10. 83	10. 17	10. 95	10. 30	11. 06			
200	Sag	3. 79	4. 51	3. 90	4. 62	4. 02	4. 73	4. 13	4. 83	4. 24	4. 94	4. 35	5. 04	4. 46	5. 14	5. 44	5. 90	5. 17
	3 Returns	10. 54	11. 50	10. 70	11. 64	10. 86	11. 78	11. 01	11. 91	11. 16	12. 04	11. 30	12. 16	11. 44	12. 28			
220	Sag	4. 58	5. 46	4. 72	5. 59	4. 86	5. 72	5. 00	5. 85	5. 13	5. 98	5. 27	6. 10	5. 40	6. 22	6. 58	7. 14	6. 26
	3 Returns	11. 59	12. 65	11. 77	12. 81	11. 94	12. 95	12. 11	13. 10	12. 27	13. 24	12. 43	13. 38	12. 58	13. 51			
240	Sag	5. 45	6. 50	5. 62	6. 65	5. 78	6. 81	5. 95	6. 96	6. 11	7. 11	6. 27	7. 26	6. 42	7. 41	7. 83	8. 50	7. 45
	3 Returns	12. 65	13. 80	12. 84	13. 97	13. 03	14. 13	13. 21	14. 29	13. 39	14. 44	13. 56	14. 59	13. 73	14. 74			
260	Sag	6. 40	7. 62	6. 59	7. 81	6. 79	7. 99	6. 98	8. 17	7. 17	8. 35	7. 35	8. 52	7. 54	8. 69	9. 19	9. 98	8. 74
	3 Returns	13. 70	14. 95	13. 91	15. 13	14. 11	15. 31	14. 31	15. 48	14. 50	15. 64	14. 69	15. 81	14. 87	15. 96			
280	Sag	7. 42	8. 84	7. 65	9. 06	7. 87	9. 27	8. 10	9. 48	8. 31	9. 68	8. 53	9. 89	8. 74	10. 08	10. 66	11. 58	10. 14
	3 Returns	14. 75	16. 10	14. 98	16. 30	15. 20	16. 48	15. 41	16. 67	15. 61	16. 85	15. 82	17. 02	16. 01	17. 19			
CONDUCTOR		TENSION (kN)																
MARS (7/3. 75)		2. 15	1. 86	2. 11	1. 83	2. 07	1. 80	2. 03	1. 77	1. 99	1. 75	1. 95	1. 72	1. 92	1. 70	1. 63	1. 53	
MERCURY (7/4. 50)		4. 13	3. 36	3. 99	3. 28	3. 87	3. 20	3. 76	3. 13	3. 65	3. 06	3. 55	3. 00	3. 46	2. 94	2. 77	2. 55	
NEPTUNE (19/3. 25)		5. 91	4. 91	5. 72	4. 79	5. 54	4. 67	5. 38	4. 56	5. 23	4. 46	5. 09	4. 36	4. 96	4. 27	4. 03	3. 70	
PLUTO (19/3. 75)		7. 55	6. 34	7. 33	6. 19	7. 12	6. 05	6. 92	5. 92	6. 74	5. 79	6. 57	5. 67	6. 41	5. 56	5. 26	4. 85	
TAURUS (19/4. 75)		12. 20	10. 20	11. 83	9. 95	11. 48	9. 72	11. 16	9. 50	10. 86	9. 30	10. 58	9. 10	10. 32	8. 92	8. 43	7. 76	
TRITON (37/3. 75)		14. 24	12. 36	13. 84	12. 07	13. 46	11. 79	13. 10	11. 52	12. 77	11. 28	12. 45	11. 04	12. 16	10. 82	10. 23	9. 41	
URANUS (61/3. 50)		17. 20	14. 94	16. 74	14. 60	16. 31	14. 28	15. 90	13. 98	15. 52	13. 69	15. 16	13. 42	14. 82	13. 17	12. 47	11. 52	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:31ºC

8.3 Sheet 15 **BARE AAC** **UTS (8% UTS)** **50m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
40	Sag	0. 37	0. 44	0. 41	0. 48	0. 45	0. 52	0. 49	0. 56	0. 53	0. 59	0. 56	0. 62	0. 60	0. 66	0. 75	0. 88	0. 67
	3 Returns	3. 30	3. 59	3. 48	3. 76	3. 65	3. 90	3. 80	4. 04	3. 94	4. 16	4. 07	4. 28	4. 19	4. 39			
50	Sag	0. 58	0. 69	0. 65	0. 75	0. 71	0. 81	0. 77	0. 87	0. 83	0. 92	0. 88	0. 98	0. 94	1. 03	1. 17	1. 37	1. 05
	3 Returns	4. 13	4. 50	4. 36	4. 70	4. 56	4. 88	4. 75	5. 05	4. 93	5. 21	5. 09	5. 36	5. 24	5. 49			
60	Sag	0. 84	0. 99	0. 93	1. 08	1. 02	1. 17	1. 11	1. 25	1. 19	1. 33	1. 27	1. 41	1. 35	1. 48	1. 68	1. 98	1. 52
	3 Returns	4. 96	5. 40	5. 23	5. 64	5. 48	5. 86	5. 71	6. 07	5. 92	6. 25	6. 11	6. 43	6. 30	6. 59			
70	Sag	1. 15	1. 36	1. 28	1. 49	1. 41	1. 61	1. 53	1. 72	1. 64	1. 83	1. 75	1. 94	1. 86	2. 04	2. 31	2. 72	2. 07
	3 Returns	5. 81	6. 33	6. 13	6. 61	6. 42	6. 87	6. 69	7. 11	6. 94	7. 33	7. 17	7. 54	7. 38	7. 73			
80	Sag	1. 50	1. 78	1. 67	1. 95	1. 84	2. 10	1. 99	2. 25	2. 14	2. 39	2. 29	2. 53	2. 42	2. 66	3. 02	3. 55	2. 70
	3 Returns	6. 64	7. 23	7. 01	7. 56	7. 34	7. 85	7. 64	8. 13	7. 93	8. 38	8. 19	8. 61	8. 43	8. 83			
90	Sag	1. 90	2. 25	2. 12	2. 46	2. 32	2. 66	2. 52	2. 85	2. 71	3. 03	2. 89	3. 20	3. 07	3. 37	3. 82	4. 50	3. 42
	3 Returns	7. 47	8. 13	7. 88	8. 50	8. 25	8. 83	8. 60	9. 14	8. 92	9. 42	9. 21	9. 69	9. 48	9. 93			
100	Sag	2. 35	2. 78	2. 61	3. 04	2. 87	3. 28	3. 11	3. 52	3. 35	3. 74	3. 57	3. 95	3. 79	4. 15	4. 72	5. 55	4. 22
	3 Returns	8. 30	9. 03	8. 75	9. 44	9. 17	9. 81	9. 55	10. 15	9. 91	10. 47	10. 23	10. 76	10. 54	11. 03			
CONDUCTOR		TENSION (kN)																
MARS (7/3. 75)		1. 21	0. 95	1. 07	0. 87	0. 96	0. 80	0. 88	0. 75	0. 81	0. 70	0. 76	0. 66	0. 71	0. 63	0. 55	0. 47	
MERCURY (7/4. 50)		1. 73	1. 35	1. 53	1. 23	1. 38	1. 14	1. 26	1. 07	1. 16	1. 00	1. 09	0. 95	1. 02	0. 90	0. 79	0. 68	
NEPTUNE (19/3. 25)		2. 28	1. 97	2. 05	1. 80	1. 87	1. 66	1. 72	1. 55	1. 60	1. 45	1. 50	1. 37	1. 41	1. 30	1. 11	0. 97	
PLUTO (19/3. 75)		3. 02	2. 55	2. 71	2. 33	2. 47	2. 16	2. 28	2. 02	2. 12	1. 90	1. 99	1. 80	1. 87	1. 71	1. 50	1. 28	
TAURUS (19/4. 75)		4. 86	4. 10	4. 37	3. 75	3. 98	3. 47	3. 67	3. 24	3. 41	3. 05	3. 19	2. 89	3. 01	2. 74	2. 42	2. 06	
TRITON (37/3. 75)		5. 86	4. 97	5. 27	4. 55	4. 81	4. 21	4. 43	3. 94	4. 12	3. 70	3. 86	3. 50	3. 64	3. 33	2. 93	2. 50	
URANUS (61/3. 50)		6. 55	6. 01	5. 98	5. 52	5. 52	5. 13	5. 14	4. 81	4. 82	4. 53	4. 55	4. 30	4. 32	4. 09	3. 62	3. 09	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:8ºC

8.3 Sheet 16 BARE AAC UTS (8% UTS) 75m RULING SPAN

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
40	Sag	0. 40	0. 44	0. 42	0. 46	0. 44	0. 48	0. 46	0. 50	0. 48	0. 52	0. 50	0. 53	0. 52	0. 55	0. 60	0. 67	0. 55
	3 Returns	3. 43	3. 60	3. 52	3. 68	3. 60	3. 75	3. 68	3. 83	3. 75	3. 90	3. 82	3. 96	3. 89	4. 02			
50	Sag	0. 63	0. 69	0. 66	0. 72	0. 69	0. 75	0. 72	0. 78	0. 75	0. 81	0. 78	0. 84	0. 81	0. 86	0. 94	1. 06	0. 86
	3 Returns	4. 29	4. 50	4. 40	4. 60	4. 50	4. 70	4. 60	4. 79	4. 69	4. 87	4. 78	4. 95	4. 87	5. 03			
60	Sag	0. 90	0. 99	0. 95	1. 04	1. 00	1. 08	1. 04	1. 13	1. 08	1. 17	1. 12	1. 21	1. 16	1. 24	1. 35	1. 52	1. 24
	3 Returns	5. 15	5. 40	5. 28	5. 52	5. 40	5. 64	5. 52	5. 75	5. 64	5. 85	5. 74	5. 95	5. 85	6. 04			
70	Sag	1. 23	1. 36	1. 29	1. 42	1. 36	1. 48	1. 42	1. 53	1. 47	1. 59	1. 53	1. 64	1. 59	1. 70	1. 85	2. 07	1. 69
	3 Returns	6. 01	6. 31	6. 16	6. 45	6. 31	6. 58	6. 45	6. 71	6. 58	6. 83	6. 70	6. 94	6. 82	7. 05			
80	Sag	1. 61	1. 77	1. 69	1. 85	1. 77	1. 93	1. 85	2. 00	1. 93	2. 08	2. 00	2. 15	2. 07	2. 22	2. 41	2. 71	2. 20
	3 Returns	6. 87	7. 21	7. 04	7. 37	7. 21	7. 52	7. 37	7. 67	7. 52	7. 81	7. 66	7. 94	7. 80	8. 06			
90	Sag	2. 05	2. 26	2. 16	2. 36	2. 26	2. 46	2. 36	2. 56	2. 46	2. 65	2. 55	2. 74	2. 64	2. 83	3. 08	3. 46	2. 79
	3 Returns	7. 75	8. 14	7. 95	8. 32	8. 14	8. 49	8. 32	8. 66	8. 49	8. 81	8. 65	8. 96	8. 81	9. 10			
100	Sag	2. 53	2. 79	2. 66	2. 91	2. 79	3. 04	2. 91	3. 15	3. 03	3. 27	3. 15	3. 38	3. 26	3. 49	3. 80	4. 27	3. 44
	3 Returns	8. 61	9. 04	8. 84	9. 24	9. 04	9. 44	9. 24	9. 62	9. 43	9. 79	9. 61	9. 95	9. 78	10. 11			
110	Sag	3. 06	3. 37	3. 22	3. 53	3. 38	3. 67	3. 53	3. 82	3. 67	3. 96	3. 81	4. 09	3. 95	4. 22	4. 60	5. 17	4. 17
	3 Returns	9. 47	9. 95	9. 72	10. 17	9. 95	10. 38	10. 17	10. 58	10. 37	10. 77	10. 57	10. 95	10. 76	11. 12			
120	Sag	3. 64	4. 01	3. 83	4. 20	4. 02	4. 37	4. 20	4. 54	4. 37	4. 71	4. 54	4. 87	4. 70	5. 03	5. 47	6. 15	4. 96
	3 Returns	10. 33	10. 85	10. 60	11. 09	10. 85	11. 32	11. 09	11. 54	11. 32	11. 74	11. 53	11. 94	11. 74	12. 13			
130	Sag	4. 27	4. 71	4. 50	4. 93	4. 71	5. 13	4. 92	5. 33	5. 13	5. 53	5. 33	5. 72	5. 52	5. 90	6. 42	7. 22	5. 82
	3 Returns	11. 19	11. 75	11. 48	12. 01	11. 75	12. 26	12. 01	12. 50	12. 26	12. 72	12. 49	12. 94	12. 71	13. 14			
CONDUCTOR		TENSION (kN)																
MARS (7/3. 75)		1. 07	0. 95	1. 01	0. 91	0. 96	0. 87	0. 92	0. 84	0. 88	0. 81	0. 85	0. 78	0. 81	0. 75	0. 69	0. 61	
MERCURY (7/4. 50)		1. 52	1. 35	1. 44	1. 29	1. 37	1. 24	1. 31	1. 19	1. 26	1. 15	1. 21	1. 11	1. 16	1. 08	0. 99	0. 88	
NEPTUNE (19/3. 25)		2. 17	1. 97	2. 06	1. 88	1. 96	1. 80	1. 87	1. 73	1. 79	1. 67	1. 73	1. 61	1. 66	1. 56	1. 43	1. 27	
PLUTO (19/3. 75)		2. 80	2. 54	2. 66	2. 43	2. 54	2. 34	2. 43	2. 25	2. 34	2. 17	2. 25	2. 10	2. 17	2. 03	1. 87	1. 64	
TAURUS (19/4. 75)		4. 51	4. 09	4. 29	3. 91	4. 09	3. 75	3. 91	3. 61	3. 76	3. 49	3. 62	3. 37	3. 49	3. 27	3. 00	2. 67	
TRITON (37/3. 75)		5. 41	4. 96	5. 15	4. 74	4. 91	4. 55	4. 71	4. 38	4. 52	4. 23	4. 36	4. 09	4. 21	3. 96	3. 64	3. 12	
URANUS (61/3. 50)		6. 32	5. 99	6. 04	5. 75	5. 80	5. 53	5. 58	5. 33	5. 38	5. 15	5. 20	4. 99	5. 03	4. 84	4. 46	3. 99	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC:10ºC

8.3 Sheet 17 BARE AAC UTS (8% UTS) 100m RULING SPAN

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0. 65	0. 69	0. 67	0. 71	0. 69	0. 73	0. 71	0. 75	0. 73	0. 76	0. 74	0. 78	0. 76	0. 80	0. 84	0. 92	0. 77
	3 Returns	4. 38	4. 51	4. 44	4. 57	4. 50	4. 62	4. 56	4. 68	4. 61	4. 73	4. 67	4. 78	4. 72	4. 83			
60	Sag	0. 94	1. 00	0. 97	1. 02	0. 99	1. 05	1. 02	1. 07	1. 05	1. 10	1. 07	1. 12	1. 10	1. 15	1. 22	1. 32	1. 11
	3 Returns	5. 25	5. 41	5. 33	5. 48	5. 40	5. 55	5. 47	5. 62	5. 54	5. 68	5. 61	5. 74	5. 67	5. 80			
70	Sag	1. 28	1. 36	1. 32	1. 39	1. 35	1. 43	1. 39	1. 46	1. 42	1. 50	1. 46	1. 53	1. 49	1. 56	1. 66	1. 80	1. 52
	3 Returns	6. 13	6. 31	6. 22	6. 40	6. 30	6. 48	6. 39	6. 55	6. 47	6. 63	6. 54	6. 70	6. 62	6. 77			
80	Sag	1. 67	1. 78	1. 72	1. 82	1. 77	1. 87	1. 82	1. 91	1. 86	1. 96	1. 91	2. 00	1. 95	2. 04	2. 17	2. 36	1. 98
	3 Returns	7. 01	7. 22	7. 11	7. 31	7. 21	7. 40	7. 30	7. 49	7. 39	7. 58	7. 48	7. 66	7. 56	7. 74			
90	Sag	2. 12	2. 25	2. 18	2. 31	2. 24	2. 37	2. 30	2. 42	2. 36	2. 48	2. 41	2. 53	2. 47	2. 59	2. 74	2. 98	2. 51
	3 Returns	7. 89	8. 12	8. 00	8. 23	8. 11	8. 33	8. 22	8. 43	8. 32	8. 53	8. 42	8. 62	8. 51	8. 71			
100	Sag	2. 63	2. 80	2. 71	2. 87	2. 79	2. 94	2. 86	3. 01	2. 93	3. 08	3. 00	3. 15	3. 07	3. 22	3. 41	3. 71	3. 10
	3 Returns	8. 79	9. 05	8. 92	9. 17	9. 04	9. 29	9. 16	9. 40	9. 27	9. 51	9. 38	9. 61	9. 49	9. 71			
110	Sag	3. 19	3. 38	3. 28	3. 47	3. 37	3. 56	3. 46	3. 64	3. 55	3. 73	3. 63	3. 81	3. 71	3. 89	4. 12	4. 49	3. 75
	3 Returns	9. 67	9. 96	9. 81	10. 09	9. 94	10. 22	10. 07	10. 34	10. 20	10. 45	10. 32	10. 57	10. 44	10. 68			
120	Sag	3. 79	4. 03	3. 90	4. 13	4. 01	4. 24	4. 12	4. 34	4. 22	4. 44	4. 32	4. 54	4. 42	4. 63	4. 91	5. 34	4. 46
	3 Returns	10. 55	10. 86	10. 70	11. 01	10. 84	11. 14	10. 99	11. 28	11. 12	11. 40	11. 25	11. 53	11. 38	11. 65			
130	Sag	4. 45	4. 72	4. 58	4. 85	4. 71	4. 97	4. 83	5. 09	4. 95	5. 21	5. 07	5. 32	5. 19	5. 44	5. 76	6. 27	5. 24
	3 Returns	11. 42	11. 77	11. 59	11. 92	11. 75	12. 07	11. 90	12. 21	12. 05	12. 35	12. 19	12. 49	12. 33	12. 62			
CONDUCTOR		TENSION (kN)																
MARS (7/3. 75)		1. 02	0. 95	0. 98	0. 92	0. 96	0. 90	0. 93	0. 88	0. 91	0. 86	0. 88	0. 84	0. 86	0. 82	0. 77	0. 71	
MERCURY (7/4. 50)		1. 44	1. 34	1. 40	1. 31	1. 36	1. 28	1. 32	1. 25	1. 29	1. 22	1. 26	1. 19	1. 23	1. 17	1. 01	1. 01	
NEPTUNE (19/3. 25)		2. 09	1. 96	2. 03	1. 91	1. 97	1. 86	1. 92	1. 82	1. 87	1. 77	1. 82	1. 73	1. 78	1. 70	1. 60	1. 46	
PLUTO (19/3. 75)		2. 69	2. 54	2. 61	2. 47	2. 54	2. 41	2. 48	2. 35	2. 42	2. 30	2. 36	2. 25	2. 31	2. 21	2. 08	1. 91	
TAURUS (19/4. 75)		4. 33	4. 08	4. 21	3. 97	4. 09	3. 88	3. 99	3. 78	3. 89	3. 70	3. 80	3. 62	3. 71	3. 54	3. 34	3. 07	
TRITON (37/3. 75)		5. 21	4. 95	5. 06	4. 82	4. 93	4. 70	4. 80	4. 59	4. 69	4. 49	4. 58	4. 39	4. 48	4. 30	4. 06	3. 73	
URANUS (61/3. 50)		6. 18	5. 98	6. 02	5. 83	5. 87	5. 70	5. 74	5. 57	5. 61	5. 45	5. 49	5. 34	5. 38	5. 23	4. 95	4. 57	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:10ºC

8.3 Sheet 18 BARE AAC UTS (14% UTS) 75m RULING SPAN

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0.27	0.40	0.30	0.44	0.33	0.48	0.37	0.52	0.41	0.55	0.45	0.59	0.48	0.63	0.72	0.86	0.57
	3 Returns	2.80	3.42	2.96	3.59	3.13	3.75	3.30	3.90	3.46	4.03	3.62	4.16	3.77	4.28			
60	Sag	0.38	0.57	0.43	0.63	0.48	0.69	0.53	0.75	0.59	0.80	0.64	0.85	0.70	0.90	1.04	1.25	0.82
	3 Returns	3.36	4.10	3.55	4.31	3.75	4.50	3.96	4.68	4.15	4.84	4.34	5.00	4.52	5.14			
70	Sag	0.52	0.78	0.59	0.86	0.65	0.94	0.73	1.02	0.80	1.09	0.88	1.16	0.95	1.23	1.42	1.70	1.12
	3 Returns	3.92	4.79	4.15	5.03	4.38	5.25	4.62	5.46	4.85	5.65	5.07	5.83	5.28	6.00			
80	Sag	0.68	1.02	0.77	1.12	0.85	1.23	0.95	1.33	1.05	1.42	1.14	1.52	1.24	1.60	1.85	2.22	1.47
	3 Returns	4.48	5.47	4.74	5.75	5.01	6.00	5.28	6.24	5.54	6.46	5.80	6.67	6.04	6.86			
90	Sag	0.87	1.29	0.97	1.42	1.08	1.55	1.20	1.68	1.33	1.80	1.45	1.92	1.57	2.03	2.35	2.81	1.86
	3 Returns	5.04	6.16	5.33	6.47	5.64	6.75	5.94	7.02	6.24	7.27	6.52	7.50	6.79	7.72			
100	Sag	1.08	1.60	1.20	1.77	1.35	1.93	1.49	2.09	1.65	2.24	1.80	2.39	1.95	2.53	2.92	3.49	2.29
	3 Returns	5.62	6.86	5.95	7.21	6.28	7.53	6.62	7.83	6.95	8.11	7.27	8.37	7.57	8.61			
110	Sag	1.30	1.94	1.46	2.14	1.63	2.34	1.81	2.53	1.99	2.71	2.18	2.89	2.36	3.06	3.53	4.22	2.77
	3 Returns	6.18	7.55	6.54	7.93	6.91	8.28	7.28	8.61	7.65	8.92	8.00	9.20	8.33	9.47			
120	Sag	1.55	2.31	1.73	2.55	1.94	2.78	2.15	3.01	2.37	3.22	2.59	3.43	2.81	3.64	4.20	5.03	3.30
	3 Returns	6.74	8.23	7.13	8.65	7.54	9.03	7.94	9.39	8.34	9.72	8.72	10.04	9.08	10.33			
130	Sag	1.82	2.71	2.03	2.99	2.27	3.26	2.52	3.53	2.78	3.78	3.04	4.03	3.30	4.27	4.93	5.90	3.87
	3 Returns	7.30	8.92	7.73	9.37	8.17	9.78	8.61	10.17	9.04	10.53	9.45	10.87	9.84	11.19			
140	Sag	2.11	3.14	2.36	3.47	2.63	3.78	2.93	4.09	3.23	4.39	3.53	4.67	3.83	4.95	5.72	6.85	4.49
	3 Returns	7.86	9.60	8.32	10.08	8.79	10.54	9.27	10.95	9.73	11.34	10.17	11.71	10.60	12.04			
150	Sag	2.42	3.61	2.71	3.98	3.02	4.34	3.36	4.70	3.70	5.04	4.05	5.37	4.39	5.68	6.57	7.86	5.16
	3 Returns	8.42	10.29	8.91	10.80	9.42	11.29	9.93	11.74	10.42	12.15	10.90	12.54	11.35	12.90			
CONDUCTOR		TENSION (kN)																
MARS (7/3.75)		1.66	1.50	1.37	1.27	1.18	1.10	1.04	1.66	1.50	1.37	1.27	1.18	1.10	1.04	0.92	0.75	
MERCURY (7/4.50)		3.41	2.36	3.02	2.14	2.69	1.95	2.41	1.80	2.19	1.68	2.00	1.58	1.84	1.49	1.29	1.07	
NEPTUNE (19/3.25)		3.45	3.12	2.85	2.62	2.44	2.29	2.15	3.45	3.12	2.85	2.62	2.44	2.29	2.15	1.86	1.55	
PLUTO (19/3.75)		6.65	4.46	5.94	4.04	5.32	3.71	4.79	3.43	4.35	3.20	3.97	3.00	3.66	2.84	2.46	2.05	
TAURUS (19/4.75)		7.17	6.49	5.94	5.49	5.12	4.80	4.53	7.17	6.49	5.94	5.49	5.12	4.80	4.53	3.92	3.27	
TRITON (37/3.75)		11.75	8.70	10.53	7.89	9.48	7.22	8.58	6.68	7.83	6.22	7.21	5.84	6.68	5.51	4.77	3.98	
URANUS (61/3.50)		10.52	9.56	8.79	8.14	7.61	7.15	6.76	10.52	9.56	8.79	8.14	7.61	7.15	6.76	5.87	4.92	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:19ºC

8.3 Sheet 19 **BARE AAC** **UTS (14% UTS)** **100m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																
SPAN LENGTH (m)	ELEMENT	Temperature																BLOWOUT (m)
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0. 29	0. 40	0. 32	0. 42	0. 34	0. 45	0. 37	0. 47	0. 40	0. 50	0. 42	0. 52	0. 45	0. 54	0. 61	0. 71	0. 56
	3 Returns	2. 94	3. 42	3. 06	3. 53	3. 18	3. 63	3. 30	3. 73	3. 41	3. 83	3. 52	3. 92	3. 62	4. 00	4. 23	4. 56	
60	Sag	0. 42	0. 57	0. 46	0. 61	0. 50	0. 65	0. 53	0. 68	0. 57	0. 72	0. 61	0. 75	0. 64	0. 79	0. 88	1. 02	0. 81
	3 Returns	3. 52	4. 10	3. 67	4. 24	3. 82	4. 36	3. 96	4. 48	4. 09	4. 59	4. 22	4. 70	4. 35	4. 80	5. 08	5. 47	
70	Sag	0. 58	0. 78	0. 63	0. 83	0. 68	0. 88	0. 73	0. 93	0. 78	0. 98	0. 83	1. 03	0. 88	1. 07	1. 20	1. 38	1. 11
	3 Returns	4. 11	4. 79	4. 29	4. 94	4. 46	5. 09	4. 62	5. 23	4. 78	5. 36	4. 93	5. 49	5. 07	5. 60	5. 93	6. 36	
80	Sag	0. 75	1. 02	0. 82	1. 09	0. 88	1. 15	0. 95	1. 22	1. 02	1. 28	1. 08	1. 34	1. 15	1. 40	1. 56	1. 81	1. 45
	3 Returns	4. 70	5. 47	4. 90	5. 65	5. 10	5. 82	5. 28	5. 98	5. 46	6. 13	5. 63	6. 27	5. 80	6. 41	6. 76	7. 29	
90	Sag	0. 95	1. 29	1. 04	1. 38	1. 12	1. 46	1. 20	1. 54	1. 29	1. 62	1. 37	1. 70	1. 45	1. 77	1. 98	2. 29	1. 83
	3 Returns	5. 29	6. 16	5. 51	6. 36	5. 73	6. 55	5. 95	6. 73	6. 15	6. 90	6. 34	7. 06	6. 52	7. 21	7. 62	8. 19	
100	Sag	1. 18	1. 61	1. 29	1. 71	1. 39	1. 82	1. 50	1. 92	1. 60	2. 01	1. 70	2. 11	1. 80	2. 20	2. 46	2. 85	2. 26
	3 Returns	5. 90	6. 87	6. 15	7. 09	6. 39	7. 30	6. 63	7. 50	6. 85	7. 69	7. 07	7. 87	7. 27	8. 04	8. 49	9. 14	
120	Sag	1. 71	2. 31	1. 85	2. 47	2. 00	2. 62	2. 15	2. 76	2. 30	2. 90	2. 45	3. 04	2. 59	3. 17	3. 54	4. 10	3. 26
	3 Returns	7. 07	8. 24	7. 37	8. 51	7. 67	8. 76	7. 95	9. 00	8. 22	9. 22	8. 48	9. 44	8. 72	9. 64	10. 19	10. 97	
140	Sag	2. 32	3. 15	2. 52	3. 36	2. 73	3. 56	2. 93	3. 76	3. 13	3. 95	3. 33	4. 13	3. 53	4. 31	4. 82	5. 58	4. 43
	3 Returns	8. 25	9. 61	8. 60	9. 92	8. 94	10. 22	9. 27	10. 50	9. 59	10. 76	9. 89	11. 01	10. 18	11. 24	11. 89	12. 79	
160	Sag	3. 03	4. 11	3. 29	4. 38	3. 56	4. 65	3. 83	4. 91	4. 09	5. 16	4. 35	5. 40	4. 61	5. 63	6. 30	7. 30	5. 79
	3 Returns	9. 43	10. 98	9. 83	11. 34	10. 22	11. 68	10. 60	11. 99	10. 96	12. 29	11. 30	12. 58	11. 63	12. 85	13. 59	14. 63	
180	Sag	3. 84	5. 20	4. 17	5. 55	4. 51	5. 88	4. 84	6. 21	5. 18	6. 53	5. 51	6. 83	5. 84	7. 13	7. 97	9. 24	7. 33
	3 Returns	10. 61	12. 35	11. 06	12. 75	11. 50	13. 13	11. 92	13. 49	12. 33	13. 83	12. 71	14. 15	13. 08	14. 45	15. 29	16. 46	
200	Sag	4. 73	6. 42	5. 15	6. 85	5. 56	7. 26	5. 98	7. 67	6. 40	8. 06	6. 80	8. 44	7. 21	8. 81	9. 85	11. 42	9. 06
	3 Returns	11. 79	13. 72	12. 29	14. 17	12. 77	14. 59	13. 24	14. 99	13. 69	15. 36	14. 12	15. 72	14. 53	16. 06	17. 00	8. 30	
CONDUCTOR		TENSION (kN)																
MARS (7/3. 75)		2. 14	1. 66	1. 97	1. 55	1. 82	1. 46	1. 69	1. 38	1. 58	1. 31	1. 49	1. 25	1. 40	1. 20	1. 07	0. 92	
MERCURY (7/4. 50)		3. 08	2. 36	2. 83	2. 21	2. 61	2. 08	2. 43	1. 97	2. 27	1. 87	2. 13	1. 79	2. 02	1. 71	1. 53	1. 32	
NEPTUNE (19/3. 25)		4. 62	3. 45	4. 24	3. 22	3. 92	3. 03	3. 64	2. 86	3. 39	2. 72	3. 19	2. 59	3. 01	2. 48	2. 21	1. 90	
PLUTO (19/3. 75)		6. 04	4. 46	5. 56	4. 18	5. 14	3. 94	4. 78	3. 73	4. 47	3. 55	4. 21	3. 39	3. 97	3. 25	2. 91	2. 15	
TAURUS (19/4. 75)		9. 77	7. 17	8. 97	6. 71	8. 29	6. 32	7. 70	5. 99	7. 19	5. 69	6. 76	5. 43	6. 38	5. 21	4. 65	4. 01	
TRITON (37/3. 75)		10. 91	8. 69	10. 09	8. 14	9. 37	7. 68	8. 76	7. 27	8. 22	6. 91	7. 76	6. 60	7. 35	6. 32	5. 65	4. 87	
URANUS (61/3. 50)		12. 80	10. 50	11. 91	9. 87	11. 13	9. 33	10. 46	8. 85	9. 87	8. 44	9. 35	8. 07	8. 89	7. 74	6. 94	6. 01	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC:20ºC

8.3 Sheet 20 BARE AAC UTS (14% UTS) 150m RULING SPAN

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
80	Sag	0. 87	1. 02	0. 91	1. 06	0. 94	1. 09	0. 98	1. 12	1. 01	1. 15	1. 04	1. 19	1. 08	1. 22	1. 30	1. 44	1. 22
	3 Returns	5. 05	5. 48	5. 16	5. 57	5. 26	5. 66	5. 35	5. 74	5. 45	5. 82	5. 53	5. 90	5. 62	5. 97			
90	Sag	1. 10	1. 30	1. 15	1. 34	1. 19	1. 38	1. 24	1. 42	1. 28	1. 46	1. 32	1. 50	1. 36	1. 54	1. 65	1. 82	1. 55
	3 Returns	5. 69	6. 17	5. 80	6. 27	5. 91	6. 37	6. 02	6. 46	6. 13	6. 55	6. 23	6. 64	6. 32	6. 72			
100	Sag	1. 36	1. 60	1. 42	1. 65	1. 47	1. 71	1. 53	1. 76	1. 58	1. 81	1. 63	1. 85	1. 68	1. 90	2. 04	2. 25	1. 91
	3 Returns	6. 32	6. 85	6. 45	6. 97	6. 57	7. 07	6. 69	7. 18	6. 81	7. 28	6. 92	7. 38	7. 03	7. 47			
110	Sag	1. 65	1. 94	1. 71	2. 00	1. 78	2. 06	1. 85	2. 13	1. 91	2. 19	1. 98	2. 25	2. 04	2. 30	2. 47	2. 73	2. 31
	3 Returns	6. 95	7. 54	7. 09	7. 66	7. 23	7. 78	7. 36	7. 90	7. 49	8. 01	7. 61	8. 12	7. 73	8. 22			
120	Sag	1. 96	2. 31	2. 04	2. 38	2. 12	2. 46	2. 20	2. 53	2. 28	2. 60	2. 35	2. 67	2. 43	2. 74	2. 94	3. 25	2. 75
	3 Returns	7. 58	8. 23	7. 74	8. 36	7. 89	8. 49	8. 03	8. 62	8. 17	8. 74	8. 31	8. 86	8. 44	8. 97			
130	Sag	2. 30	2. 71	2. 40	2. 80	2. 49	2. 89	2. 58	2. 97	2. 67	3. 06	2. 76	3. 14	2. 85	3. 22	3. 45	3. 81	3. 23
	3 Returns	8. 22	8. 91	8. 39	9. 06	8. 55	9. 20	8. 70	9. 34	8. 86	9. 47	9. 00	9. 59	9. 14	9. 72			
140	Sag	2. 68	3. 15	2. 79	3. 26	2. 90	3. 36	3. 01	3. 46	3. 11	3. 56	3. 22	3. 66	3. 32	3. 75	4. 02	4. 44	3. 75
	3 Returns	8. 87	9. 62	9. 05	9. 78	9. 23	9. 93	9. 40	10. 08	9. 56	10. 22	9. 71	10. 36	9. 87	10. 49			
150	Sag	3. 08	3. 62	3. 20	3. 74	3. 33	3. 86	3. 45	3. 97	3. 57	4. 09	3. 69	4. 20	3. 81	4. 30	4. 62	5. 10	4. 30
	3 Returns	9. 50	10. 31	9. 70	10. 48	9. 88	10. 64	10. 07	10. 80	10. 24	10. 95	10. 41	11. 09	10. 57	11. 24			
160	Sag	3. 50	4. 12	3. 65	4. 26	3. 79	4. 39	3. 93	4. 52	4. 07	4. 65	4. 20	4. 78	4. 33	4. 90	5. 25	5. 80	4. 89
	3 Returns	10. 13	10. 99	10. 34	11. 17	10. 54	11. 35	10. 74	11. 52	10. 92	11. 68	11. 10	11. 83	11. 27	11. 98			
170	Sag	3. 95	4. 65	4. 12	4. 81	4. 28	4. 96	4. 44	5. 10	4. 59	5. 25	4. 74	5. 39	4. 89	5. 53	5. 93	6. 55	5. 53
	3 Returns	10. 77	11. 68	10. 99	11. 87	11. 20	12. 06	11. 41	12. 23	11. 60	12. 41	11. 79	12. 57	11. 98	12. 73			
180	Sag	4. 43	5. 21	4. 61	5. 39	4. 80	5. 56	4. 97	5. 72	5. 15	5. 89	5. 32	6. 04	5. 48	6. 20	6. 65	7. 35	6. 20
	3 Returns	11. 40	12. 37	11. 63	12. 57	11. 86	12. 76	12. 08	12. 95	12. 29	13. 14	12. 49	13. 31	12. 68	13. 48			
CONDUCTOR		TENSION (kN)																
MARS (7/3. 75)		1. 95	1. 66	1. 87	1. 60	1. 79	1. 55	1. 73	1. 51	1. 67	1. 46	1. 61	1. 42	1. 56	1. 39	1. 29	1. 16	
MERCURY (7/4. 50)		2. 70	2. 36	2. 59	2. 28	2. 49	2. 21	2. 40	2. 14	2. 32	2. 08	2. 25	2. 03	2. 18	1. 97	1. 84	1. 66	
NEPTUNE (19/3. 25)		4. 08	3. 44	3. 90	3. 33	3. 75	3. 22	3. 61	3. 12	3. 48	3. 03	3. 36	2. 94	3. 25	2. 87	2. 66	2. 40	
PLUTO (19/3. 75)		5. 23	4. 45	5. 02	4. 30	4. 83	4. 17	4. 66	4. 05	4. 50	3. 94	4. 36	3. 84	4. 23	3. 74	3. 49	3. 16	
TAURUS (19/4. 75)		8. 45	7. 15	8. 10	6. 91	7. 79	6. 70	7. 50	6. 50	7. 25	6. 32	7. 01	6. 15	6. 79	6. 00	5. 59	5. 05	
TRITON (37/3. 75)		9. 81	8. 67	9. 44	8. 39	9. 09	8. 13	8. 78	7. 89	8. 49	7. 67	8. 23	7. 46	7. 99	7. 27	6. 78	6. 13	
URANUS (61/3. 50)		11. 71	10. 48	11. 29	10. 15	10. 91	9. 85	10. 57	9. 58	10. 24	9. 32	9. 95	9. 09	9. 67	8. 87	8. 29	7. 52	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:22ºC

AAAC

8.3 Sheet 21 **BARE AAAC (1120)** **SLACK (2% UTS)** **20m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
10	Sag	0. 07	0. 07	0. 08	0. 08	0. 08	0. 09	0. 09	0. 09	0. 09	0. 10	0. 10	0. 10	0. 10	0. 11	0. 12	0. 14	0. 11
	3 Returns	1. 45	1. 48	1. 51	1. 54	1. 57	1. 59	1. 62	1. 64	1. 67	1. 69	1. 71	1. 73	1. 74	1. 77			
15	Sag	0. 16	0. 17	0. 18	0. 18	0. 19	0. 20	0. 20	0. 21	0. 21	0. 22	0. 23	0. 23	0. 24	0. 24	0. 27	0. 32	0. 24
	3 Returns	2. 18	2. 23	2. 28	2. 32	2. 36	2. 40	2. 44	2. 48	2. 51	2. 55	2. 58	2. 61	2. 63	2. 67			
20	Sag	0. 29	0. 30	0. 32	0. 33	0. 34	0. 35	0. 36	0. 37	0. 38	0. 39	0. 40	0. 42	0. 42	0. 43	0. 49	0. 57	0. 43
	3 Returns	2. 92	2. 98	3. 04	3. 10	3. 16	3. 21	3. 26	3. 31	3. 36	3. 40	3. 44	3. 49	3. 52	3. 57			
25	Sag	0. 47	0. 49	0. 51	0. 53	0. 55	0. 56	0. 58	0. 60	0. 62	0. 63	0. 65	0. 67	0. 68	0. 70	0. 78	0. 91	0. 67
	3 Returns	3. 70	3. 78	3. 86	3. 93	4. 00	4. 07	4. 13	4. 20	4. 25	4. 31	4. 36	4. 42	4. 46	4. 52			
30	Sag	0. 67	0. 70	0. 73	0. 76	0. 78	0. 81	0. 84	0. 86	0. 89	0. 91	0. 93	0. 96	0. 97	1. 00	1. 13	1. 31	0. 97
	3 Returns	4. 43	4. 53	4. 62	4. 71	4. 80	4. 88	4. 95	5. 03	5. 10	5. 17	5. 23	5. 30	5. 34	5. 42			
35	Sag	0. 91	0. 95	0. 99	1. 03	1. 07	1. 10	1. 14	1. 17	1. 21	1. 24	1. 27	1. 30	1. 32	1. 36	1. 53	1. 78	1. 32
	3 Returns	5. 17	5. 28	5. 39	5. 49	5. 59	5. 69	5. 78	5. 87	5. 94	6. 03	6. 10	6. 18	6. 23	6. 32			
40	Sag	1. 19	1. 24	1. 29	1. 34	1. 39	1. 44	1. 49	1. 53	1. 57	1. 62	1. 66	1. 70	1. 73	1. 78	2. 00	2. 32	1. 73
	3 Returns	5. 90	6. 03	6. 16	6. 28	6. 39	6. 50	6. 60	6. 70	6. 79	6. 89	6. 97	7. 06	7. 11	7. 22			
CONDUCTOR		TENSION (kN)																
CHLORINE (7/2. 50)		0. 20	0. 16	0. 17	0. 15	0. 16	0. 14	0. 15	0. 13	0. 14	0. 12	0. 13	0. 11	0. 12	0. 11	0. 09	0. 08	
HYDROGEN (7/4. 50)		0. 51	0. 49	0. 47	0. 45	0. 43	0. 42	0. 41	0. 39	0. 38	0. 37	0. 36	0. 35	0. 35	0. 34	0. 30	0. 25	
KRYPTON (19/3. 25)		0. 80	0. 75	0. 72	0. 68	0. 66	0. 63	0. 62	0. 59	0. 58	0. 56	0. 55	0. 53	0. 52	0. 50	0. 44	0. 37	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC: 2ºC

8.3 Sheet 22 **BARE AAAC (1120)** **SLACK (2% UTS)** **40m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
20	Sag	0. 31	0. 31	0. 32	0. 32	0. 32	0. 33	0. 33	0. 33	0. 34	0. 34	0. 34	0. 35	0. 35	0. 35	0. 37	0. 40	0. 33
	3 Returns	3. 02	3. 04	3. 05	3. 07	3. 08	3. 10	3. 11	3. 13	3. 15	3. 16	3. 18	3. 19	3. 20	3. 22			
25	Sag	0. 47	0. 48	0. 48	0. 49	0. 49	0. 50	0. 50	0. 51	0. 51	0. 52	0. 52	0. 53	0. 53	0. 54	0. 57	0. 61	0. 51
	3 Returns	3. 72	3. 74	3. 76	3. 78	3. 80	3. 82	3. 84	3. 86	3. 88	3. 90	3. 91	3. 94	3. 95	3. 97			
30	Sag	0. 68	0. 69	0. 70	0. 70	0. 71	0. 72	0. 73	0. 73	0. 74	0. 75	0. 75	0. 76	0. 77	0. 78	0. 82	0. 88	0. 74
	3 Returns	4. 47	4. 50	4. 52	4. 55	4. 56	4. 59	4. 61	4. 64	4. 66	4. 69	4. 70	4. 73	4. 75	4. 77			
35	Sag	0. 93	0. 94	0. 95	0. 96	0. 97	0. 98	0. 99	1. 00	1. 01	1. 02	1. 03	1. 04	1. 05	1. 06	1. 11	1. 20	1. 00
	3 Returns	5. 21	5. 25	5. 27	5. 31	5. 33	5. 36	5. 38	5. 42	5. 44	5. 47	5. 49	5. 52	5. 54	5. 57			
40	Sag	1. 21	1. 23	1. 24	1. 26	1. 27	1. 28	1. 29	1. 31	1. 32	1. 33	1. 34	1. 36	1. 37	1. 38	1. 46	1. 57	1. 31
	3 Returns	5. 96	6. 00	6. 03	6. 07	6. 09	6. 13	6. 16	6. 19	6. 22	6. 25	6. 28	6. 31	6. 34	6. 37			
45	Sag	1. 56	1. 58	1. 59	1. 61	1. 63	1. 65	1. 66	1. 68	1. 69	1. 71	1. 73	1. 75	1. 76	1. 78	1. 87	2. 02	1. 66
	3 Returns	6. 76	6. 80	6. 83	6. 88	6. 91	6. 95	6. 98	7. 02	7. 05	7. 09	7. 11	7. 15	7. 18	7. 22			
50	Sag	1. 90	1. 92	1. 94	1. 97	1. 98	2. 01	2. 03	2. 05	2. 07	2. 09	2. 11	2. 13	2. 15	2. 17	2. 28	2. 46	2. 05
	3 Returns	7. 46	7. 51	7. 54	7. 59	7. 62	7. 67	7. 70	7. 75	7. 78	7. 82	7. 85	7. 90	7. 93	7. 97			
55	Sag	2. 32	2. 36	2. 38	2. 41	2. 43	2. 46	2. 48	2. 51	2. 53	2. 56	2. 58	2. 61	2. 63	2. 66	2. 80	3. 01	2. 48
	3 Returns	8. 25	8. 31	8. 34	8. 40	8. 44	8. 49	8. 52	8. 57	8. 61	8. 66	8. 69	8. 74	8. 77	8. 82			
60	Sag	2. 77	2. 80	2. 83	2. 87	2. 89	2. 93	2. 95	2. 99	3. 01	3. 05	3. 07	3. 11	3. 13	3. 16	3. 33	3. 59	2. 95
	3 Returns	9. 00	9. 06	9. 10	9. 16	9. 20	9. 26	9. 30	9. 35	9. 39	9. 44	9. 48	9. 53	9. 57	9. 62			
70	Sag	3. 77	3. 82	3. 85	3. 90	3. 94	3. 99	4. 02	4. 07	4. 10	4. 15	4. 18	4. 23	4. 26	4. 31	4. 53	4. 89	4. 02
	3 Returns	10. 50	10. 57	10. 61	10. 68	10. 73	10. 80	10. 84	10. 91	10. 95	11. 01	11. 05	11. 12	11. 16	11. 22			
80	Sag	4. 92	4. 99	5. 04	5. 10	5. 15	5. 21	5. 25	5. 32	5. 36	5. 43	5. 47	5. 53	5. 57	5. 63	5. 93	6. 39	5. 26
	3 Returns	11. 99	12. 07	12. 13	12. 21	12. 26	12. 34	12. 39	12. 46	12. 51	12. 58	12. 63	12. 70	12. 74	12. 82			
CONDUCTOR		TENSION (kN)																
CHLORINE (7/2. 50)		0. 17	0. 16	0. 17	0. 16	0. 16	0. 15	0. 16	0. 15	0. 15	0. 15	0. 15	0. 14	0. 15	0. 14	0. 13	0. 12	
HYDROGEN (7/4. 50)		0. 49	0. 48	0. 48	0. 47	0. 47	0. 46	0. 46	0. 45	0. 45	0. 44	0. 44	0. 44	0. 43	0. 43	0. 40	0. 37	
KRYPTON (19/3. 25)		0. 76	0. 74	0. 74	0. 72	0. 72	0. 71	0. 70	0. 69	0. 69	0. 68	0. 67	0. 66	0. 66	0. 65	0. 61	0. 56	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:2ºC

8.3 Sheet 23 **BARE AAAC (1120)** **URBAN (6% UTS)** **40m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
20	Sag	0. 09	0. 10	0. 11	0. 12	0. 12	0. 13	0. 13	0. 15	0. 15	0. 16	0. 16	0. 17	0. 17	0. 19	0. 22	0. 26	0. 19
	3 Returns	1. 44	1. 75	1. 67	1. 87	1. 89	1. 98	2. 11	2. 08	2. 32	2. 17	2. 52	2. 26	2. 71	2. 33			
30	Sag	0. 20	0. 23	0. 23	0. 26	0. 26	0. 29	0. 29	0. 32	0. 32	0. 35	0. 35	0. 38	0. 38	0. 41	0. 48	0. 58	0. 43
	3 Returns	2. 43	2. 59	2. 61	2. 77	2. 79	2. 94	2. 94	3. 09	3. 08	3. 22	3. 21	3. 34	3. 33	3. 45			
40	Sag	0. 36	0. 41	0. 41	0. 47	0. 47	0. 52	0. 53	0. 58	0. 58	0. 63	0. 63	0. 68	0. 67	0. 72	0. 85	1. 03	0. 76
	3 Returns	3. 24	3. 45	3. 49	3. 70	3. 72	3. 92	3. 93	4. 12	4. 12	4. 30	4. 29	4. 46	4. 45	4. 61			
50	Sag	0. 56	0. 64	0. 65	0. 73	0. 74	0. 82	0. 82	0. 91	0. 90	0. 99	0. 98	1. 06	1. 05	1. 13	1. 33	1. 61	1. 18
	3 Returns	4. 06	4. 32	4. 36	4. 63	4. 65	4. 91	4. 91	5. 16	5. 15	5. 38	5. 37	5. 58	5. 56	5. 76			
60	Sag	0. 82	0. 93	0. 95	1. 06	1. 07	1. 20	1. 20	1. 32	1. 32	1. 44	1. 43	1. 55	1. 54	1. 65	1. 93	2. 34	1. 70
	3 Returns	4. 89	5. 21	5. 27	5. 59	5. 61	5. 92	5. 93	6. 22	6. 22	6. 49	6. 48	6. 73	6. 71	6. 96			
70	Sag	1. 11	1. 26	1. 29	1. 45	1. 46	1. 63	1. 63	1. 80	1. 79	1. 95	1. 94	2. 10	2. 09	2. 24	2. 63	3. 18	2. 32
	3 Returns	5. 71	6. 08	6. 14	6. 52	6. 55	6. 91	6. 91	7. 26	7. 25	7. 57	7. 55	7. 85	7. 83	8. 11			
80	Sag	1. 45	1. 64	1. 68	1. 89	1. 91	2. 12	2. 13	2. 34	2. 34	2. 55	2. 54	2. 75	2. 73	2. 93	3. 44	4. 16	3. 03
	3 Returns	6. 52	6. 95	7. 02	7. 45	7. 48	7. 89	7. 90	8. 29	8. 28	8. 65	8. 63	8. 97	8. 95	9. 27			
CONDUCTOR		TENSION (kN)																
CHLORINE (7/2. 50)		0. 67	0. 49	0. 58	0. 42	0. 50	0. 37	0. 43	0. 33	0. 39	0. 30	0. 35	0. 28	0. 32	0. 26	0. 22	0. 18	
HYDROGEN (7/4. 50)		1. 65	1. 46	1. 43	1. 27	1. 26	1. 13	1. 13	1. 02	1. 03	0. 94	0. 94	0. 87	0. 88	0. 82	0. 69	0. 57	
KRYPTON (19/3. 25)		2. 57	2. 24	2. 22	1. 93	1. 94	1. 70	1. 73	1. 53	1. 56	1. 40	1. 43	1. 29	1. 33	1. 21	1. 02	0. 83	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:5ºC

8.3 Sheet 24 **BARE AAAC (1120)** **URBAN (6% UTS)** **60m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
30	Sag	0. 21	0. 23	0. 23	0. 25	0. 24	0. 26	0. 25	0. 28	0. 28	0. 29	0. 29	0. 31	0. 30	0. 32	0. 36	0. 42	0. 33
	3 Returns	2. 47	2. 59	2. 58	2. 69	2. 67	2. 78	2. 76	2. 86	2. 84	2. 94	2. 92	3. 01	2. 99	3. 08			
40	Sag	0. 37	0. 41	0. 40	0. 44	0. 43	0. 47	0. 46	0. 50	0. 49	0. 52	0. 52	0. 55	0. 54	0. 58	0. 65	0. 75	0. 59
	3 Returns	3. 30	3. 46	3. 44	3. 59	3. 57	3. 71	3. 68	3. 82	3. 79	3. 92	3. 90	4. 02	3. 99	4. 11			
50	Sag	0. 58	0. 64	0. 63	0. 69	0. 68	0. 73	0. 72	0. 78	0. 77	0. 82	0. 81	0. 86	0. 85	0. 90	1. 01	1. 18	0. 92
	3 Returns	4. 13	4. 32	4. 30	4. 49	4. 46	4. 64	4. 61	4. 78	4. 75	4. 91	4. 88	5. 03	5. 00	5. 14			
60	Sag	0. 84	0. 92	0. 91	0. 99	0. 98	1. 06	1. 04	1. 12	1. 11	1. 18	1. 17	1. 24	1. 23	1. 30	1. 46	1. 70	1. 33
	3 Returns	4. 96	5. 19	5. 17	5. 39	5. 36	5. 57	5. 53	5. 74	5. 70	5. 89	5. 85	6. 04	6. 00	6. 17			
70	Sag	1. 14	1. 25	1. 24	1. 35	1. 33	1. 44	1. 42	1. 53	1. 51	1. 61	1. 59	1. 69	1. 67	1. 77	1. 99	2. 31	1. 81
	3 Returns	5. 79	6. 06	6. 03	6. 29	6. 25	6. 50	6. 46	6. 69	6. 65	6. 88	6. 83	7. 05	7. 00	7. 21			
80	Sag	1. 50	1. 65	1. 63	1. 77	1. 75	1. 90	1. 87	2. 01	1. 99	2. 12	2. 10	2. 23	2. 20	2. 33	2. 62	3. 05	2. 37
	3 Returns	6. 64	6. 95	6. 92	7. 21	7. 17	7. 46	7. 41	7. 68	7. 63	7. 89	7. 84	8. 09	8. 03	8. 27			
90	Sag	1. 90	2. 08	2. 06	2. 24	2. 22	2. 40	2. 37	2. 54	2. 51	2. 69	2. 65	2. 82	2. 79	2. 95	3. 32	3. 86	3. 00
	3 Returns	7. 47	7. 82	7. 78	8. 11	8. 07	8. 39	8. 34	8. 64	8. 59	8. 87	8. 82	9. 09	9. 04	9. 30			
100	Sag	2. 35	2. 57	2. 55	2. 77	2. 74	2. 96	2. 92	3. 14	3. 10	3. 32	3. 27	3. 48	3. 44	3. 64	4. 09	4. 76	3. 70
	3 Returns	8. 30	8. 69	8. 65	9. 01	8. 96	9. 32	9. 26	9. 60	9. 54	9. 86	9. 80	10. 10	10. 04	10. 33			
CONDUCTOR		TENSION (kN)																
CHLORINE (7/2. 50)		0. 62	0. 49	0. 56	0. 45	0. 51	0. 42	0. 47	0. 39	0. 44	0. 37	0. 41	0. 35	0. 39	0. 33	0. 29	0. 25	
HYDROGEN (7/4. 50)		1. 59	1. 46	1. 47	1. 35	1. 37	1. 26	1. 28	1. 19	1. 21	1. 13	1. 14	1. 08	1. 09	1. 03	0. 91	0. 78	
KRYPTON (19/3. 25)		2. 49	2. 24	2. 28	2. 06	2. 11	1. 92	1. 96	1. 80	1. 84	1. 69	1. 74	1. 61	1. 65	1. 53	1. 35	1. 15	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:5ºC

8.3 Sheet 25 **BARE AAAC (1120)** **URBAN (6% UTS)** **80m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
40	Sag	0. 38	0. 41	0. 40	0. 43	0. 42	0. 44	0. 44	0. 46	0. 46	0. 48	0. 47	0. 50	0. 49	0. 51	0. 56	0. 63	0. 51
	3 Returns	3. 35	3. 46	3. 43	3. 54	3. 51	3. 61	3. 59	3. 68	3. 66	3. 75	3. 72	3. 81	3. 79	3. 88			
50	Sag	0. 60	0. 64	0. 63	0. 67	0. 66	0. 70	0. 69	0. 72	0. 71	0. 75	0. 74	0. 78	0. 77	0. 80	0. 87	0. 96	0. 80
	3 Returns	4. 19	4. 33	4. 30	4. 42	4. 39	4. 52	4. 49	4. 61	4. 58	4. 69	4. 66	4. 77	4. 74	4. 85			
60	Sag	0. 86	0. 92	0. 91	0. 96	0. 95	1. 00	0. 99	1. 04	1. 03	1. 08	1. 07	1. 12	1. 10	1. 15	1. 06	1. 42	1. 16
	3 Returns	5. 03	5. 19	5. 16	5. 31	5. 28	5. 42	5. 39	5. 53	5. 49	5. 63	5. 59	5. 73	5. 69	5. 82			
70	Sag	1. 18	1. 25	1. 23	1. 31	1. 29	1. 37	1. 35	1. 42	1. 40	1. 47	1. 45	1. 52	1. 50	1. 57	1. 71	1. 93	1. 58
	3 Returns	5. 88	6. 06	6. 02	6. 20	6. 16	6. 33	6. 29	6. 46	6. 41	6. 57	6. 53	6. 69	6. 64	6. 79			
80	Sag	1. 54	1. 64	1. 61	1. 71	1. 69	1. 79	1. 76	1. 86	1. 83	1. 92	1. 90	1. 99	1. 97	2. 06	2. 24	2. 52	2. 06
	3 Returns	6. 72	6. 93	6. 88	7. 09	7. 04	7. 24	7. 19	7. 38	7. 33	7. 51	7. 46	7. 64	7. 59	7. 77			
90	Sag	1. 95	2. 07	2. 04	2. 17	2. 14	2. 26	2. 23	2. 35	2. 32	2. 44	2. 40	2. 52	2. 49	2. 60	2. 84	3. 19	2. 61
	3 Returns	7. 56	7. 80	7. 74	7. 98	7. 92	8. 14	8. 09	8. 30	8. 25	8. 46	8. 40	8. 60	8. 54	8. 74			
100	Sag	2. 42	2. 58	2. 54	2. 70	2. 66	2. 81	2. 77	2. 92	2. 88	3. 03	2. 99	3. 14	3. 10	3. 24	3. 53	3. 98	3. 22
	3 Returns	8. 42	8. 69	8. 63	8. 89	8. 83	9. 08	9. 02	9. 26	9. 20	9. 43	9. 37	9. 59	9. 53	9. 75			
110	Sag	2. 93	3. 12	3. 07	3. 26	3. 22	3. 40	3. 35	3. 53	3. 49	3. 67	3. 62	3. 79	3. 74	3. 92	4. 27	4. 80	3. 90
	3 Returns	9. 27	9. 56	9. 49	9. 78	9. 71	9. 98	9. 92	10. 18	10. 11	10. 37	10. 30	10. 54	10. 47	10. 71			
120	Sag	3. 48	3. 71	3. 66	3. 88	3. 83	4. 05	3. 99	4. 21	4. 15	4. 36	4. 30	4. 51	4. 45	4. 66	5. 08	5. 72	4. 64
	3 Returns	10. 11	10. 43	10. 36	10. 67	10. 59	10. 89	10. 82	11. 10	11. 03	11. 31	11. 23	11. 50	11. 42	11. 69			
130	Sag	4. 09	4. 35	4. 29	4. 55	4. 49	4. 75	4. 68	4. 94	4. 87	5. 12	5. 05	5. 30	5. 23	5. 47	5. 96	6. 71	5. 45
	3 Returns	10. 95	11. 30	11. 22	11. 55	11. 47	11. 80	11. 72	12. 03	11. 95	12. 25	12. 17	12. 46	12. 38	12. 66			
140	Sag	4. 74	5. 05	4. 98	5. 28	5. 21	5. 51	5. 43	5. 73	5. 65	5. 94	5. 86	6. 15	6. 06	6. 35	6. 92	7. 79	6. 32
	3 Returns	11. 79	12. 16	12. 08	12. 44	12. 35	12. 70	12. 62	12. 95	12. 86	13. 19	13. 10	13. 41	13. 33	13. 63			
CONDUCTOR		TENSION (kN)																
CHLORINE (7/2. 50)		0. 58	0. 49	0. 54	0. 46	0. 51	0. 44	0. 49	042	0. 46	0. 41	0. 44	0. 39	0. 42	0. 38	0. 34	0. 30	
HYDROGEN (7/4. 50)		1. 55	1. 45	1. 47	1. 39	1. 41	1. 33	1. 35	1. 28	1. 30	1. 23	1. 25	1. 19	1. 21	1. 16	1. 06	0. 94	
KRYPTON (19/3. 25)		2. 42	2. 24	2. 29	2. 13	2. 17	2. 03	2. 07	1. 94	1. 98	1. 86	1. 91	1. 80	1. 83	1. 73	1. 57	1. 38	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC: 7ºC

8.3 Sheet 26 **BARE AAAC (1120)** **URBAN (6% UTS)** **100m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0. 61	0. 64	0. 63	0. 66	0. 65	0. 68	0. 67	0. 70	0. 69	0. 71	0. 71	0. 73	0. 72	0. 75	0. 80	0. 88	0. 74
	3 Returns	4. 23	4. 33	4. 30	4. 40	4. 37	4. 46	4. 43	4. 52	4. 49	4. 58	4. 55	4. 64	4. 61	4. 69			
60	Sag	0. 88	0. 92	0. 91	0. 95	0. 94	0. 98	0. 96	1. 00	0. 99	1. 03	1. 02	1. 06	1. 04	1. 08	1. 15	1. 27	1. 06
	3 Returns	5. 08	5. 20	5. 17	5. 28	5. 24	5. 35	5. 32	5. 43	5. 39	5. 50	5. 46	5. 57	5. 53	5. 63			
70	Sag	1. 20	1. 25	1. 24	1. 29	1. 28	1. 33	1. 31	1. 37	1. 35	1. 40	1. 39	1. 44	1. 42	1. 47	1. 57	1. 72	1. 45
	3 Returns	5. 93	6. 07	6. 03	6. 16	6. 12	6. 25	6. 21	6. 33	6. 29	6. 42	6. 38	6. 50	6. 46	6. 57			
80	Sag	1. 57	1. 64	1. 62	1. 69	1. 67	1. 74	1. 72	1. 79	1. 76	1. 83	1. 81	1. 88	1. 86	1. 92	2. 05	2. 25	1. 89
	3 Returns	6. 78	6. 94	6. 89	7. 04	7. 00	7. 14	7. 10	7. 24	7. 20	7. 33	7. 29	7. 42	7. 38	7. 51			
90	Sag	1. 99	2. 08	2. 05	2. 14	2. 11	2. 20	2. 17	2. 26	2. 24	2. 32	2. 29	2. 38	2. 35	2. 44	2. 60	2. 85	2. 39
	3 Returns	7. 63	7. 81	7. 75	7. 92	7. 87	8. 04	7. 99	8. 15	8. 10	8. 25	8. 20	8. 35	8. 31	8. 45			
100	Sag	2. 45	2. 56	2. 53	2. 64	2. 61	2. 72	2. 69	2. 80	2. 76	2. 87	2. 83	2. 94	2. 91	3. 01	3. 21	3. 52	2. 95
	3 Returns	8. 48	8. 67	8. 62	8. 81	8. 75	8. 93	8. 88	9. 05	9. 00	9. 17	9. 12	9. 28	9. 23	9. 39			
110	Sag	2. 97	3. 11	3. 07	3. 20	3. 16	3. 29	3. 25	3. 38	3. 34	3. 47	3. 43	3. 56	3. 52	3. 64	3. 89	4. 27	3. 57
	3 Returns	9. 33	9. 54	9. 48	9. 69	9. 63	9. 83	9. 77	9. 96	9. 90	10. 09	10. 03	10. 21	10. 15	10. 34			
120	Sag	3. 53	3. 70	3. 65	3. 81	3. 76	3. 92	3. 87	4. 03	3. 98	4. 13	4. 08	4. 24	4. 19	4. 34	4. 63	5. 08	4. 26
	3 Returns	10. 18	10. 41	10. 34	10. 57	10. 50	10. 72	10. 65	10. 87	10. 80	11. 01	10. 94	11. 14	11. 08	11. 28			
130	Sag	4. 17	4. 36	4. 30	4. 49	4. 44	4. 63	4. 57	4. 75	4. 69	4. 88	4. 82	5. 00	4. 94	5. 12	5. 46	6. 00	5. 00
	3 Returns	11. 06	11. 31	11. 23	11. 48	11. 41	11. 64	11. 57	11. 80	11. 73	11. 96	11. 88	12. 10	12. 03	12. 25			
140	Sag	4. 83	5. 06	4. 99	5. 21	5. 15	5. 36	5. 30	5. 51	5. 45	5. 66	5. 59	5. 80	5. 73	5. 94	6. 34	6. 96	5. 80
	3 Returns	11. 90	12. 18	12. 10	12. 36	12. 28	12. 54	12. 46	12. 71	12. 63	12. 87	12. 80	13. 03	12. 96	13. 19			
150	Sag	5. 55	5. 81	5. 73	5. 99	5. 91	6. 16	6. 08	6. 33	6. 25	6. 50	6. 42	6. 66	6. 58	6. 82	7. 28	7. 99	6. 65
	3 Returns	12. 75	13. 04	12. 96	13. 24	13. 16	13. 43	13. 35	13. 62	13. 53	13. 79	13. 71	13. 96	13. 88	14. 13			
CONDUCTOR		TENSION (kN)																
CHLORINE (7/2. 50)		0. 55	0. 49	0. 53	0. 47	0. 51	0. 46	0. 49	0. 44	0. 47	0. 43	0. 46	0. 42	0. 45	0. 41	0. 37	0. 34	
HYDROGEN (7/4. 50)		1. 52	1. 45	1. 47	1. 41	1. 43	1. 37	1. 38	1. 33	1. 35	1. 30	1. 31	1. 27	1. 28	1. 24	1. 15	1. 05	
KRYPTON (19/3. 25)		2. 36	2. 23	2. 28	2. 16	2. 20	2. 09	2. 13	2. 03	2. 06	1. 97	2. 00	1. 92	1. 95	1. 87	1. 73	1. 56	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:7ºC

8.3 Sheet 27 **BARE AAAC (1120)** **SEMI-URBAN (12% UTS)** **50m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
30	Sag	0. 08	0. 11	0. 10	0. 14	0. 11	0. 16	0. 13	0. 19	0. 15	0. 21	0. 18	0. 24	0. 20	0. 26	0. 32	0. 41	0. 30
	3 Returns	1. 57	1. 83	1. 69	2. 00	1. 82	2. 18	1. 97	2. 35	2. 12	2. 50	2. 28	2. 64	2. 42	2. 77			
40	Sag	0. 15	0. 20	0. 17	0. 24	0. 20	0. 29	0. 23	0. 32	0. 27	0. 38	0. 31	0. 42	0. 36	0. 47	0. 58	0. 74	0. 53
	3 Returns	2. 09	2. 44	2. 25	2. 68	2. 43	2. 91	2. 63	3. 14	2. 83	3. 34	3. 04	3. 53	3. 24	3. 70			
50	Sag	0. 23	0. 32	0. 27	0. 38	0. 31	0. 45	0. 37	0. 52	0. 43	0. 60	0. 49	0. 66	0. 56	0. 73	0. 91	1. 15	0. 82
	3 Returns	2. 62	3. 05	2. 81	3. 35	3. 04	3. 64	3. 29	3. 92	3. 54	4. 18	3. 80	4. 42	4. 05	4. 63			
60	Sag	0. 34	0. 46	0. 39	0. 54	0. 45	0. 64	0. 52	0. 73	0. 60	0. 83	0. 69	0. 92	0. 77	1. 01	1. 24	1. 57	1. 18
	3 Returns	3. 14	3. 67	3. 37	4. 00	3. 63	4. 33	3. 91	4. 64	4. 20	4. 93	4. 49	5. 19	4. 77	5. 43			
70	Sag	0. 46	0. 63	0. 53	0. 76	0. 62	0. 90	0. 73	1. 04	0. 85	1. 18	0. 97	1. 32	1. 11	1. 45	1. 80	2. 28	1. 61
	3 Returns	3. 68	4. 30	3. 96	4. 71	4. 28	5. 13	4. 62	5. 52	4. 99	5. 88	5. 35	6. 21	5. 70	6. 51			
80	Sag	0. 60	0. 82	0. 70	0. 99	0. 81	1. 17	0. 95	1. 36	1. 11	1. 54	1. 27	1. 72	1. 44	1. 89	2. 34	2. 98	2. 10
	3 Returns	4. 21	4. 91	4. 53	5. 38	4. 89	5. 86	5. 28	6. 31	5. 70	6. 72	6. 11	7. 10	6. 51	7. 44			
90	Sag	0. 76	1. 04	0. 88	1. 25	1. 03	1. 48	1. 20	1. 72	1. 40	1. 95	1. 61	2. 17	1. 83	2. 39	2. 97	3. 78	2. 66
	3 Returns	4. 73	5. 52	5. 09	6. 05	5. 50	6. 59	5. 94	7. 10	6. 41	7. 56	6. 87	7. 99	7. 32	8. 37			
100	Sag	0. 94	1. 28	1. 09	1. 54	1. 27	1. 82	1. 48	2. 12	1. 73	2. 41	1. 99	2. 68	2. 25	2. 95	3. 66	4. 66	3. 29
	3 Returns	5. 26	6. 14	5. 65	6. 73	6. 11	7. 32	6. 60	7. 88	7. 12	8. 40	7. 64	8. 87	8. 13	9. 30			
CONDUCTOR		TENSION (kN)																
CHLORINE (7/2. 50)		1. 24	0. 98	1. 09	0. 82	0. 95	0. 69	0. 82	0. 59	0. 72	0. 51	0. 63	0. 46	0. 55	0. 41	0. 32	0. 25	
HYDROGEN (7/4. 50)		3. 97	2. 91	3. 43	2. 43	2. 94	2. 05	2. 52	1. 77	2. 17	1. 56	1. 88	1. 39	1. 66	1. 27	1. 02	0. 80	
KRYPTON (19/3. 25)		5. 42	4. 49	4. 74	3. 76	4. 12	3. 18	3. 57	2. 72	3. 11	2. 38	2. 72	2. 11	2. 42	1. 91	1. 51	1. 17	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:12ºC

8.3 Sheet 28 **BARE AAAC (1120)** **SEMI-URBAN (12% UTS)** **75m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0. 23	0. 32	0. 26	0. 36	0. 30	0. 40	0. 33	0. 44	0. 37	0. 48	0. 41	0. 52	0. 45	0. 56	0. 67	0. 82	0. 63
	3 Returns	2. 62	3. 06	2. 78	3. 25	2. 96	3. 43	3. 13	3. 61	3. 30	3. 77	3. 47	3. 92	3. 63	4. 06			
60	Sag	0. 34	0. 46	0. 38	0. 52	0. 43	0. 58	0. 48	0. 64	0. 54	0. 70	0. 59	0. 75	0. 65	0. 81	0. 96	1. 18	0. 90
	3 Returns	3. 15	3. 67	3. 34	3. 90	3. 55	4. 12	3. 76	4. 33	3. 96	4. 53	4. 16	4. 70	4. 35	4. 87			
70	Sag	0. 46	0. 62	0. 52	0. 71	0. 58	0. 79	0. 65	0. 87	0. 73	0. 95	0. 80	1. 03	0. 88	1. 10	1. 31	1. 60	1. 23
	3 Returns	3. 68	4. 28	3. 90	4. 55	4. 14	4. 81	4. 38	5. 06	4. 63	5. 28	4. 86	5. 49	5. 08	5. 69			
80	Sag	0. 60	0. 82	0. 68	0. 92	0. 76	1. 03	0. 86	1. 14	0. 95	1. 24	1. 05	1. 34	1. 15	1. 44	1. 71	2. 09	1. 60
	3 Returns	4. 20	4. 89	4. 46	5. 21	4. 73	5. 50	5. 01	5. 78	5. 29	6. 04	5. 56	6. 28	5. 81	6. 50			
90	Sag	0. 76	1. 03	0. 86	1. 17	0. 97	1. 31	1. 08	1. 44	1. 21	1. 57	1. 33	1. 70	1. 46	1. 82	2. 16	2. 65	2. 03
	3 Returns	4. 73	5. 51	5. 02	5. 86	5. 33	6. 19	5. 64	6. 50	5. 95	6. 79	6. 25	7. 06	6. 54	7. 31			
100	Sag	0. 94	1. 28	1. 06	1. 44	1. 19	1. 61	1. 33	1. 77	1. 48	1. 93	1. 63	2. 08	1. 79	2. 23	2. 64	3. 23	2. 51
	3 Returns	5. 26	6. 12	5. 58	6. 50	5. 92	6. 87	6. 26	7. 21	6. 60	7. 52	6. 93	7. 82	7. 24	8. 09			
110	Sag	1. 14	1. 55	1. 29	1. 76	1. 45	1. 96	1. 63	2. 17	1. 81	2. 36	2. 00	2. 56	2. 19	2. 74	3. 25	3. 99	3. 03
	3 Returns	5. 80	6. 75	6. 15	7. 18	6. 91	7. 59	7. 29	7. 97	7. 66	8. 33	8. 01	8. 66	8. 35	8. 97			
120	Sag	1. 36	1. 85	1. 54	2. 09	1. 73	2. 34	1. 94	2. 58	2. 16	2. 81	2. 38	3. 04	2. 61	3. 26	3. 87	4. 75	3. 61
	3 Returns	6. 32	7. 36	6. 71	7. 83	7. 12	8. 28	7. 54	8. 70	7. 96	9. 09	8. 36	9. 45	8. 74	9. 78			
130	Sag	1. 60	2. 17	1. 80	2. 45	2. 03	2. 74	2. 27	3. 03	2. 53	3. 30	2. 79	3. 57	3. 06	3. 83	4. 54	5. 57	4. 24
	3 Returns	6. 85	7. 98	7. 27	8. 48	7. 72	8. 97	8. 17	9. 42	8. 62	9. 84	9. 05	10. 23	9. 47	10. 59			
140	Sag	1. 85	2. 51	2. 09	2. 84	2. 35	3. 18	2. 64	3. 51	2. 94	3. 83	3. 24	4. 14	3. 55	4. 44	5. 27	6. 46	4. 91
	3 Returns	7. 38	8. 59	7. 83	9. 14	8. 31	9. 66	8. 80	10. 15	9. 28	10. 60	9. 75	11. 02	10. 20	11. 41			
150	Sag	2. 13	2. 89	2. 40	3. 27	2. 70	3. 65	3. 03	4. 03	3. 37	4. 40	3. 72	4. 75	4. 07	5. 10	6. 05	7. 42	5. 64
	3 Returns	7. 90	9. 20	8. 39	9. 79	8. 90	10. 35	9. 42	10. 87	9. 94	11. 35	10. 45	11. 80	10. 93	12. 22			
CONDUCTOR		TENSION (kN)																
CHLORINE (7/2. 50)		1. 27	0. 98	1. 14	0. 86	1. 02	0. 77	0. 92	0. 69	0. 83	0. 63	0. 75	0. 58	0. 69	0. 54	0. 45	0. 36	
HYDROGEN (7/4. 50)		3. 95	2. 91	3. 51	2. 58	3. 11	2. 31	2. 78	2. 09	2. 50	1. 91	2. 26	1. 77	2. 07	1. 65	1. 39	1. 13	
KRYPTON (19/3. 25)		5. 42	4. 49	4. 86	3. 97	4. 36	3. 54	3. 93	3. 20	3. 56	2. 92	3. 25	2. 69	2. 98	2. 50	2. 08	1. 68	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:13ºC

8.3 Sheet 29 BARE AAAC (1120) SEMI-URBAN (12% UTS) 100m RULING SPAN

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0. 24	0. 32	0. 27	0. 35	0. 29	0. 37	0. 32	0. 40	0. 35	0. 43	0. 37	0. 45	0. 40	0. 48	0. 55	0. 65	0. 53
	3 Returns	2. 68	3. 06	2. 81	3. 19	2. 94	3. 32	3. 07	3. 44	3. 19	3. 55	3. 31	3. 65	3. 42	3. 75			
60	Sag	0. 35	0. 46	0. 39	0. 50	0. 42	0. 54	0. 46	0. 58	0. 50	0. 62	0. 54	0. 66	0. 58	0. 69	0. 79	0. 94	0. 76
	3 Returns	3. 22	3. 67	3. 37	3. 83	3. 53	3. 98	3. 68	4. 13	3. 83	4. 26	3. 97	4. 39	4. 11	4. 51			
70	Sag	0. 48	0. 62	0. 53	0. 68	0. 58	0. 74	0. 63	0. 79	0. 68	0. 84	0. 73	0. 89	0. 78	0. 94	1. 08	1. 28	1. 03
	3 Returns	3. 76	4. 28	3. 94	4. 47	4. 12	4. 65	4. 30	4. 82	4. 47	4. 97	4. 64	5. 12	4. 80	5. 26			
80	Sag	0. 63	0. 82	0. 69	0. 89	0. 76	0. 96	0. 82	1. 03	0. 89	1. 10	0. 96	1. 17	1. 02	1. 23	1. 41	1. 68	1. 35
	3 Returns	4. 29	4. 90	4. 50	5. 11	4. 71	5. 31	4. 92	5. 51	5. 11	5. 68	5. 30	5. 85	5. 48	6. 01			
90	Sag	0. 79	1. 03	0. 87	1. 13	0. 96	1. 22	1. 04	1. 31	1. 13	1. 39	1. 21	1. 48	1. 30	1. 56	1. 79	2. 13	1. 71
	3 Returns	4. 83	5. 51	5. 07	5. 75	5. 30	5. 98	5. 53	6. 19	5. 75	6. 40	5. 97	6. 59	6. 17	6. 76			
100	Sag	0. 98	1. 28	1. 08	1. 39	1. 18	1. 50	1. 29	1. 61	1. 39	1. 72	1. 50	1. 83	1. 60	1. 93	2. 21	2. 63	2. 11
	3 Returns	5. 37	6. 12	5. 63	6. 39	5. 89	6. 65	6. 15	6. 88	6. 39	7. 11	6. 63	7. 32	6. 86	7. 52			
110	Sag	1. 19	1. 55	1. 31	1. 68	1. 43	1. 82	1. 56	1. 95	1. 69	2. 08	1. 81	2. 21	1. 94	2. 33	2. 67	3. 18	2. 55
	3 Returns	5. 91	6. 73	6. 19	7. 03	6. 48	7. 31	6. 76	7. 57	7. 03	7. 82	7. 30	8. 05	7. 54	8. 27			
120	Sag	1. 41	1. 84	1. 56	2. 01	1. 70	2. 17	1. 85	2. 33	2. 01	2. 48	2. 16	2. 63	2. 31	2. 78	3. 18	3. 78	3. 04
	3 Returns	6. 44	7. 35	6. 76	7. 67	7. 07	7. 98	7. 38	8. 26	7. 67	8. 53	7. 96	8. 79	8. 23	9. 02			
130	Sag	1. 67	2. 17	1. 84	2. 37	2. 01	2. 56	2. 19	2. 74	2. 37	2. 93	2. 55	3. 10	2. 72	3. 27	3. 75	4. 66	3. 57
	3 Returns	7. 00	7. 98	7. 34	8. 33	7. 68	8. 66	8. 01	8. 97	8. 33	9. 27	8. 64	9. 54	8. 94	9. 80			
140	Sag	1. 93	2. 52	2. 13	2. 74	2. 33	2. 97	2. 54	3. 18	2. 75	3. 39	2. 95	3. 60	3. 16	3. 80	4. 35	5. 18	4. 14
	3 Returns	7. 54	8. 59	7. 90	8. 97	8. 27	9. 33	8. 63	9. 66	8. 97	9. 98	9. 31	10. 27	9. 62	10. 55			
150	Sag	2. 22	2. 89	2. 44	3. 15	2. 67	3. 40	2. 91	3. 65	3. 15	3. 90	3. 39	4. 13	3. 62	4. 36	5. 00	5. 94	4. 75
	3 Returns	8. 07	9. 21	8. 47	9. 61	8. 86	9. 99	9. 24	10. 35	9. 62	10. 69	9. 97	11. 01	10. 31	11. 30			
CONDUCTOR		TENSION (kN)																
CHLORINE (7/2. 50)		1. 26	0. 98	1. 15	0. 89	1. 05	0. 82	0. 97	0. 76	0. 89	0. 71	0. 83	0. 67	0. 77	0. 63	0. 54	0. 45	
HYDROGEN (7/4. 50)		3. 79	2. 91	3. 44	2. 67	3. 14	2. 47	2. 89	2. 30	2. 67	2. 16	2. 48	2. 04	2. 32	1. 93	1. 68	1. 41	
KRYPTON (19/3. 25)		5. 31	4. 48	4. 86	4. 09	4. 46	3. 77	4. 12	3. 49	3. 82	3. 26	3. 56	3. 06	3. 33	2. 89	2. 49	2. 08	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC: 15ºC

8.3 Sheet 30 **BARE AAAC (1120)** **SEMI-URBAN (12% UTS)** **150m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
80	Sag	0. 69	0. 82	0. 73	0. 86	0. 77	0. 90	0. 81	0. 93	0. 85	0. 97	0. 88	1. 00	0. 92	1. 04	1. 14	1. 29	1. 10
	3 Returns	4. 51	4. 90	4. 63	5. 02	4. 75	5. 13	4. 87	5. 23	4. 98	5. 33	5. 09	5. 43	5. 19	5. 52			
100	Sag	1. 08	1. 28	1. 14	1. 34	1. 20	1. 40	1. 26	1. 46	1. 32	1. 52	1. 38	1. 57	1. 44	1. 63	1. 78	2. 02	1. 72
	3 Returns	5. 63	6. 13	5. 79	6. 27	5. 94	6. 41	6. 09	6. 54	6. 23	6. 67	6. 36	6. 79	6. 49	6. 91			
120	Sag	1. 56	1. 84	1. 65	1. 93	1. 73	2. 02	1. 82	2. 10	1. 91	2. 18	1. 99	2. 26	2. 07	2. 34	2. 57	2. 91	2. 47
	3 Returns	6. 76	7. 35	6. 95	7. 53	7. 13	7. 69	7. 31	7. 85	7. 48	8. 01	7. 64	8. 15	7. 79	8. 29			
140	Sag	2. 12	2. 51	2. 24	2. 63	2. 36	2. 75	2. 48	2. 86	2. 59	2. 97	2. 71	3. 08	2. 82	3. 19	3. 49	3. 96	3. 36
	3 Returns	7. 89	8. 58	8. 11	8. 78	8. 32	8. 98	8. 53	9. 16	8. 73	9. 34	8. 91	9. 51	9. 10	9. 67			
160	Sag	2. 77	3. 28	2. 93	3. 44	3. 09	3. 59	3. 24	3. 74	3. 39	3. 88	3. 54	4. 02	3. 68	4. 16	4. 56	5. 16	4. 39
	3 Returns	9. 02	9. 81	9. 27	10. 04	9. 52	10. 26	9. 75	10. 47	9. 97	10. 67	10. 19	10. 86	10. 39	11. 05			
180	Sag	3. 51	4. 15	3. 71	4. 35	3. 91	4. 54	4. 10	4. 74	4. 29	4. 92	4. 48	5. 10	4. 66	5. 28	5. 78	6. 55	5. 56
	3 Returns	10. 15	11. 03	10. 43	11. 30	10. 71	11. 55	10. 97	11. 78	11. 22	12. 01	11. 46	12. 23	11. 70	12. 44			
200	Sag	4. 35	5. 14	4. 59	5. 39	4. 84	5. 63	5. 08	5. 87	5. 32	6. 10	5. 55	6. 32	5. 78	6. 54	7. 16	8. 12	6. 87
	3 Returns	11. 29	12. 28	11. 61	12. 57	11. 91	12. 85	12. 21	13. 12	12. 49	13. 37	12. 76	13. 61	13. 02	13. 84			
220	Sag	5. 27	6. 22	5. 56	6. 52	5. 86	6. 81	6. 15	7. 09	6. 43	7. 37	6. 71	7. 64	6. 99	7. 90	8. 65	9. 81	8. 31
	3 Returns	12. 43	13. 51	12. 77	13. 83	13. 11	14. 13	13. 43	14. 42	13. 73	14. 70	14. 03	14. 96	14. 31	15. 22			
240	Sag	6. 26	7. 40	6. 62	7. 76	6. 97	8. 11	7. 32	8. 45	7. 66	8. 78	7. 99	9. 10	8. 32	9. 42	10. 32	11. 70	9. 90
	3 Returns	13. 55	14. 73	13. 93	15. 08	14. 30	15. 42	14. 65	15. 74	14. 98	16. 04	15. 31	16. 33	15. 62	16. 61			
260	Sag	7. 35	8. 69	7. 77	9. 11	8. 18	9. 52	8. 59	9. 92	8. 99	10. 31	9. 38	10. 69	9. 77	11. 06	12. 12	13. 74	11. 62
	3 Returns	14. 68	15. 96	15. 09	16. 34	15. 49	16. 70	15. 87	17. 05	16. 23	17. 38	16. 58	17. 69	16. 92	17. 99			
280	Sag	8. 52	10. 08	9. 01	10. 57	9. 49	11. 04	9. 96	11. 50	10. 43	11. 96	10. 88	12. 40	11. 33	12. 83	14. 06	15. 94	13. 48
	3 Returns	15. 81	17. 19	16. 25	17. 60	16. 68	17. 99	17. 09	18. 36	17. 48	18. 71	17. 86	19. 05	18. 22	19. 38			
CONDUCTOR		TENSION (kN)																
CHLORINE (7/2. 50)		1. 20	0. 98	1. 13	0. 93	1. 07	0. 89	1. 01	0. 85	0. 96	0. 81	0. 92	0. 78	0. 88	0. 75	0. 67	0. 64	
HYDROGEN (7/4. 50)		3. 44	2. 91	3. 25	2. 77	3. 09	2. 66	2. 94	2. 55	2. 81	2. 45	2. 69	2. 37	2. 59	2. 29	2. 08	1. 84	
KRYPTON (19/3. 25)		5. 03	4. 48	4. 76	4. 25	4. 52	4. 05	4. 31	3. 87	4. 11	3. 72	3. 94	3. 57	3. 78	3. 44	3. 11	2. 72	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC:17ºC

8.3 Sheet 31 **BARE AAAC (1120)** **RURAL (20% UTS)** **100m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
60	Sag	0. 18	0. 27	0. 20	0. 31	0. 22	0. 35	0. 24	0. 39	0. 26	0. 43	0. 29	0. 47	0. 32	0. 51	0. 63	0. 80	0. 63
	3 Returns	2. 31	2. 84	2. 41	3. 01	2. 52	3. 19	2. 63	3. 37	2. 76	3. 54	2. 90	3. 71	3. 05	3. 87			
70	Sag	0. 25	0. 37	0. 27	0. 42	0. 29	0. 47	0. 32	0. 53	0. 35	0. 58	0. 39	0. 64	0. 43	0. 69	0. 86	1. 09	0. 85
	3 Returns	2. 70	3. 32	2. 81	3. 52	2. 94	3. 72	3. 08	3. 93	3. 23	4. 13	3. 39	4. 33	3. 56	4. 52			
80	Sag	0. 32	0. 49	0. 35	0. 55	0. 38	0. 62	0. 42	0. 69	0. 46	0. 76	0. 51	0. 83	0. 56	0. 91	1. 12	1. 43	1. 11
	3 Returns	3. 09	3. 79	3. 22	4. 02	3. 36	4. 26	3. 52	4. 49	3. 69	4. 73	3. 87	4. 95	4. 07	5. 16			
90	Sag	0. 41	0. 62	0. 45	0. 70	0. 49	0. 78	0. 53	0. 87	0. 59	0. 96	0. 65	1. 06	0. 71	1. 15	1. 42	1. 81	1. 41
	3 Returns	3. 47	4. 26	3. 62	4. 52	3. 78	4. 79	3. 96	5. 06	4. 15	5. 32	4. 36	5. 57	4. 58	5. 81			
100	Sag	0. 51	0. 77	0. 55	0. 86	0. 60	0. 96	0. 66	1. 08	0. 72	1. 19	0. 80	1. 31	0. 88	1. 42	1. 75	2. 23	1. 74
	3 Returns	3. 86	4. 74	4. 02	5. 03	4. 20	5. 32	4. 40	5. 62	4. 61	5. 91	4. 84	6. 19	5. 09	6. 46			
110	Sag	0. 61	0. 93	0. 67	1. 04	0. 73	1. 17	0. 80	1. 30	0. 88	1. 44	0. 97	1. 58	1. 07	1. 72	2. 12	2. 70	2. 10
	3 Returns	4. 24	5. 21	4. 42	5. 53	4. 62	5. 85	4. 84	6. 18	5. 07	6. 50	5. 33	6. 81	5. 60	7. 10			
120	Sag	0. 73	1. 10	0. 79	1. 24	0. 87	1. 39	0. 95	1. 55	1. 04	1. 71	1. 15	1. 88	1. 27	2. 05	2. 52	3. 21	2. 50
	3 Returns	4. 63	5. 69	4. 83	6. 03	5. 04	6. 39	5. 28	6. 74	5. 53	7. 09	5. 81	7. 43	6. 11	7. 75			
130	Sag	0. 86	1. 30	0. 94	1. 46	1. 02	1. 64	1. 12	1. 83	1. 23	2. 02	1. 36	2. 22	1. 50	2. 41	2. 97	3. 79	2. 94
	3 Returns	5. 03	6. 18	5. 24	6. 55	5. 47	6. 94	5. 73	7. 32	6. 01	7. 70	6. 31	8. 07	6. 63	8. 42			
140	Sag	1. 00	1. 51	1. 08	1. 70	1. 18	1. 90	1. 30	2. 12	1. 43	2. 34	1. 57	2. 57	1. 74	2. 80	3. 44	4. 40	3. 41
	3 Returns	5. 42	6. 65	5. 64	7. 05	5. 89	7. 47	6. 17	7. 89	6. 47	8. 30	6. 80	8. 69	7. 14	9. 06			
150	Sag	1. 15	1. 73	1. 25	1. 95	1. 36	2. 18	1. 49	2. 43	1. 64	2. 69	1. 81	2. 95	1. 99	3. 21	3. 95	5. 05	3. 91
	3 Returns	5. 80	7. 13	6. 05	7. 56	6. 32	8. 00	6. 61	8. 45	6. 93	8. 89	7. 28	9. 31	7. 65	9. 71			
160	Sag	1. 30	1. 97	142	2. 21	1. 55	2. 48	1. 69	2. 77	1. 86	3. 06	2. 05	3. 36	2. 27	3. 65	4. 50	5. 74	4. 45
	3 Returns	6. 19	7. 60	6. 45	8. 06	6. 74	8. 53	7. 05	9. 01	7. 39	9. 48	7. 77	9. 93	8. 16	10. 35			
CONDUCTOR		TENSION (kN)																
CHLORINE (7/2. 50)		2. 14	1. 64	1. 97	1. 46	1. 80	1. 30	1. 64	1. 17	1. 50	1. 05	1. 37	0. 95	1. 24	0. 87	0. 69	0. 53	
HYDROGEN (7/4. 50)		7. 33	4. 86	6. 75	4. 32	6. 19	3. 85	5. 65	3. 46	5. 13	3. 12	4. 65	2. 85	4. 22	2. 62	2. 12	1. 66	
KRYPTON (19/3. 25)		9. 53	7. 48	8. 77	6. 70	8. 04	5. 99	7. 35	5. 38	6. 71	4. 85	6. 11	4. 40	5. 57	4. 03	3. 22	2. 47	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:23ºC

8.3 Sheet 32 **BARE AAAC (1120)** **RURAL (20% UTS)** **150m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
80	Sag	0. 34	0. 49	0. 36	0. 53	0. 39	0. 57	0. 42	0. 62	0. 45	0. 66	0. 49	0. 70	0. 52	0. 74	0. 86	1. 05	0. 88
	3 Returns	3. 14	3. 79	3. 26	3. 95	3. 38	4. 11	3. 51	4. 26	3. 65	4. 40	3. 78	4. 54	3. 92	4. 67			
100	Sag	0. 52	0. 77	0. 56	0. 83	0. 61	0. 90	0. 66	0. 96	0. 71	1. 03	0. 76	1. 10	0. 82	1. 16	1. 35	1. 64	1. 38
	3 Returns	3. 93	4. 74	4. 07	4. 94	4. 23	5. 13	4. 39	5. 32	4. 56	5. 50	4. 73	5. 68	4. 91	5. 84			
120	Sag	0. 76	1. 10	0. 81	1. 20	0. 88	1. 29	0. 95	1. 39	1. 02	1. 49	1. 10	1. 58	1. 18	1. 68	1. 95	2. 36	1. 98
	3 Returns	4. 71	5. 69	4. 89	5. 93	5. 07	6. 16	5. 27	6. 39	5. 47	6. 61	5. 68	6. 82	5. 89	7. 02			
140	Sag	1. 03	1. 50	1. 11	1. 63	1. 19	1. 76	1. 29	1. 89	1. 39	2. 02	1. 50	2. 16	1. 61	2. 28	2. 63	3. 21	2. 70
	3 Returns	5. 50	6. 64	5. 70	6. 92	5. 92	7. 19	6. 15	7. 45	6. 39	7. 71	6. 63	7. 95	6. 87	8. 19			
160	Sag	1. 35	1. 96	1. 45	2. 13	1. 56	2. 30	1. 68	2. 47	1. 81	2. 64	1. 95	2. 81	2. 10	2. 98	3. 46	4. 18	3. 53
	3 Returns	6. 29	7. 59	6. 52	7. 91	6. 77	8. 22	7. 03	8. 52	7. 30	8. 81	7. 57	9. 08	7. 85	9. 35			
180	Sag	1. 70	2. 48	1. 83	2. 70	1. 98	2. 91	2. 13	3. 13	2. 30	3. 35	2. 47	3. 57	2. 66	3. 78	4. 39	5. 31	4. 47
	3 Returns	7. 07	8. 54	7. 33	8. 90	7. 61	9. 25	7. 91	9. 59	8. 21	9. 91	852	10. 23	8. 84	10. 53			
200	Sag	2. 11	3. 08	2. 27	3. 34	2. 45	3. 61	2. 64	3. 88	2. 85	4. 15	3. 07	4. 42	3. 30	4. 68	5. 43	6. 58	5. 52
	3 Returns	7. 87	9. 50	8. 16	9. 90	8. 47	10. 29	8. 80	10. 67	9. 14	11. 03	9. 48	11. 38	9. 84	11. 72			
220	Sag	2. 55	3. 72	2. 75	4. 04	2. 96	4. 36	3. 19	4. 69	3. 44	5. 01	3. 71	5. 34	3. 99	5. 65	6. 56	7. 94	6. 68
	3 Returns	8. 66	10. 45	8. 98	10. 89	9. 32	11. 31	9. 68	11. 73	10. 05	12. 13	10. 43	12. 51	10. 81	12. 88			
240	Sag	3. 04	4. 43	3. 27	4. 81	3. 52	5. 20	3. 80	5. 59	4. 10	5. 97	4. 41	6. 36	4. 75	6. 74	7. 83	9. 48	7. 95
	3 Returns	9. 44	11. 40	9. 79	11. 88	10. 17	12. 35	10. 56	12. 80	10. 96	13. 24	11. 38	13. 66	11. 80	14. 06			
260	Sag	3. 56	5. 20	3. 83	5. 64	4. 13	6. 10	4. 46	6. 56	4. 81	7. 01	5. 18	7. 46	5. 57	7. 91	9. 19	11. 12	9. 33
	3 Returns	10. 23	12. 35	10. 61	12. 87	11. 01	13. 37	11. 44	13. 87	11. 88	14. 34	12. 33	14. 79	12. 78	15. 23			
280	Sag	4. 13	6. 03	4. 45	6. 55	4. 79	7. 07	5. 17	7. 60	5. 58	8. 13	6. 01	8. 66	6. 46	9. 17	10. 66	12. 91	10. 82
	3 Returns	11. 01	13. 30	11. 42	13. 86	11. 86	14. 40	12. 32	14. 93	12. 79	15. 44	13. 28	15. 93	13. 77	16. 40			
CONDUCTOR		TENSION (kN)																
CHLORINE (7/2. 50)		2. 10	1. 63	1. 95	1. 50	1. 81	1. 39	1. 68	1. 29	1. 57	1. 20	1. 46	1. 12	1. 36	1. 05	0. 96	0. 79	
HYDROGEN (7/4. 50)		7. 08	4. 85	6. 58	4. 47	6. 11	4. 14	5. 66	3. 85	5. 25	3. 60	4. 87	3. 38	4. 53	3. 19	2. 75	2. 27	
KRYPTON (19/3. 25)		9. 33	7. 47	8. 69	6. 89	8. 08	6. 37	7. 52	5. 91	7. 01	5. 51	6. 54	5. 16	6. 11	4. 85	4. 13	3. 37	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:25ºC

8.3 Sheet 33 **BARE AAAC (1120)** **RURAL (20% UTS)** **200m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
100	Sag	0. 56	0. 77	0. 59	0. 81	0. 63	0. 86	0. 67	0. 90	0. 71	0. 95	0. 75	0. 99	0. 79	1. 03	1. 16	1. 35	1. 19
	3 Returns	4. 04	4. 74	4. 17	4. 88	4. 30	5. 02	4. 43	5. 15	4. 56	5. 27	4. 69	5. 40	4. 82	5. 51			
120	Sag	0. 80	1. 10	0. 85	1. 17	0. 91	1. 24	0. 96	1. 30	1. 02	1. 37	1. 08	1. 43	1. 14	1. 49	1. 67	1. 95	1. 71
	3 Returns	4. 85	5. 69	5. 01	5. 86	5. 16	6. 02	5. 32	6. 18	5. 48	6. 33	5. 63	6. 48	5. 79	6. 62			
140	Sag	1. 09	1. 50	1. 16	1. 59	1. 24	1. 68	1. 31	1. 77	1. 39	1. 86	1. 47	1. 95	1. 55	2. 03	2. 27	2. 65	2. 33
	3 Returns	5. 66	6. 64	5. 84	6. 84	6. 02	7. 03	6. 21	7. 21	6. 39	7. 39	6. 57	7. 56	6. 75	7. 72			
160	Sag	1. 43	1. 96	1. 52	2. 08	1. 62	2. 20	1. 72	2. 31	1. 82	2. 43	1. 92	2. 54	2. 03	2. 65	2. 97	3. 46	3. 04
	3 Returns	6. 47	7. 59	6. 68	7. 82	6. 89	8. 03	7. 10	8. 24	7. 31	8. 44	7. 52	8. 64	7. 72	8. 82			
180	Sag	1. 81	2. 49	1. 92	2. 64	2. 05	2. 78	2. 17	2. 93	2. 30	3. 08	2. 44	3. 22	2. 57	3. 36	3. 76	4. 38	3. 85
	3 Returns	7. 28	8. 54	7. 51	8. 79	7. 75	9. 04	7. 98	9. 27	8. 22	9. 50	8. 46	9. 72	8. 69	9. 93			
200	Sag	2. 24	3. 08	2. 38	3. 26	2. 53	3. 45	2. 69	3. 63	2. 85	3. 81	3. 02	3. 99	3. 18	4. 16	4. 66	5. 43	4. 75
	3 Returns	8. 11	9. 51	8. 36	9. 79	8. 62	10. 06	8. 89	10. 32	9. 15	10. 57	9. 41	10. 82	9. 67	11. 05			
220	Sag	2. 71	3. 73	2. 88	3. 95	3. 06	4. 17	3. 25	4. 39	3. 45	4. 61	3. 65	4. 82	3. 85	5. 03	5. 64	6. 57	5. 75
	3 Returns	8. 92	10. 46	9. 20	10. 77	9. 48	11. 06	9. 77	11. 35	10. 06	11. 63	10. 35	11. 90	10. 63	12. 15			
240	Sag	3. 22	4. 43	3. 43	4. 70	3. 65	4. 97	3. 87	5. 23	4. 11	5. 49	4. 34	5. 74	4. 59	5. 99	6. 71	7. 82	6. 84
	3 Returns	9. 73	11. 41	10. 03	11. 74	10. 35	12. 07	10. 66	12. 38	10. 98	12. 69	11. 29	12. 98	11. 60	13. 26			
260	Sag	3. 78	5. 20	4. 03	5. 52	4. 28	5. 83	4. 54	6. 13	4. 82	6. 44	5. 10	6. 74	5. 38	7. 03	7. 88	9. 18	8. 03
	3 Returns	10. 54	12. 36	10. 87	12. 72	11. 21	13. 07	11. 55	13. 41	11. 89	13. 74	12. 23	14. 06	12. 57	14. 36			
280	Sag	4. 39	6. 04	4. 67	6. 40	4. 96	6. 76	5. 27	7. 11	5. 59	7. 47	5. 91	7. 81	6. 24	8. 15	9. 14	10. 65	9. 32
	3 Returns	11. 35	13. 31	11. 70	13. 70	12. 07	14. 08	12. 44	14. 45	12. 80	14. 80	13. 17	15. 14	13. 53	15. 46			
300	Sag	5. 04	6. 93	5. 36	7. 34	5. 70	7. 76	6. 05	8. 17	6. 41	8. 57	6. 79	8. 97	7. 16	9. 36	10. 49	12. 23	10. 70
	3 Returns	12. 16	14. 26	12. 54	14. 68	12. 93	15. 09	13. 32	15. 48	13. 72	15. 86	14. 11	16. 22	14. 50	16. 57			
CONDUCTOR		TENSION (kN)																
CHLORINE (7/2. 50)		2. 00	1. 54	1. 89	1. 45	1. 78	1. 37	1. 68	1. 30	1. 59	1. 24	1. 50	1. 18	1. 43	1. 13	1. 00	0. 86	
HYDROGEN (7/4. 50)		6. 67	4. 85	6. 27	4. 58	5. 90	4. 33	5. 55	4. 12	5. 24	3. 92	4. 95	3. 75	4. 69	3. 59	3. 20	2. 75	
KRYPTON (19/3. 25)		9. 03	7. 47	8. 51	7. 03	8. 03	6. 64	7. 59	6. 29	7. 18	5. 97	6. 81	5. 69	6. 48	5. 44	4. 81	4. 08	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:27ºC

8.3 Sheet 34 **BARE AAAC (1120)** **RURAL (20% UTS)** **250m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
120	Sag	0. 86	1. 11	0. 90	1. 15	0. 94	1. 20	0. 99	1. 25	1. 03	1. 29	1. 08	1. 34	1. 12	1. 38	1. 51	1. 71	1. 54
	3 Returns	5. 01	5. 70	5. 14	5. 82	5. 26	5. 94	5. 39	6. 05	5. 51	6. 16	5. 63	6. 27	5. 74	6. 37			
140	Sag	1. 17	1. 50	1. 22	1. 57	1. 28	1. 63	1. 35	1. 70	1. 41	1. 76	1. 47	1. 82	1. 53	1. 88	2. 06	2. 33	2. 09
	3 Returns	5. 85	6. 65	6. 00	6. 79	6. 14	6. 93	6. 29	7. 06	6. 43	7. 19	6. 57	7. 31	6. 70	7. 43			
160	Sag	1. 52	1. 97	1. 60	2. 05	1. 68	2. 14	1. 76	2. 22	1. 84	2. 30	1. 92	2. 38	2. 00	2. 46	2. 69	3. 05	2. 74
	3 Returns	6. 69	7. 60	6. 85	7. 76	7. 02	7. 92	7. 18	8. 07	7. 35	8. 22	7. 50	8. 36	7. 66	8. 50			
180	Sag	1. 93	2. 49	2. 03	2. 60	2. 13	2. 70	2. 23	2. 81	2. 33	2. 91	2. 43	3. 01	2. 53	3. 12	3. 41	3. 86	3. 46
	3 Returns	7. 52	8. 55	7. 71	8. 73	7. 90	8. 91	8. 08	9. 08	8. 27	9. 25	8. 44	9. 41	8. 62	9. 56			
200	Sag	2. 39	3. 08	2. 51	3. 22	2. 63	3. 35	2. 76	3. 48	2. 88	3. 61	3. 01	3. 73	3. 13	3. 86	4. 22	4. 78	4. 28
	3 Returns	8. 37	9. 51	8. 58	9. 72	8. 79	9. 91	9. 00	10. 11	9. 20	10. 29	9. 40	10. 47	9. 59	10. 64			
220	Sag	2. 89	3. 73	3. 04	3. 89	3. 18	4. 05	3. 34	4. 21	3. 49	4. 37	3. 64	4. 52	3. 79	4. 67	5. 10	5. 78	5. 18
	3 Returns	9. 21	10. 46	9. 44	10. 69	9. 67	10. 91	9. 89	11. 12	10. 12	11. 32	10. 34	11. 51	10. 55	11. 70			
240	Sag	3. 44	4. 44	3. 61	4. 63	3. 79	4. 82	3. 97	5. 01	4. 15	5. 20	4. 33	5. 38	4. 51	5. 56	6. 07	6. 88	6. 16
	3 Returns	10. 04	11. 41	10. 30	11. 66	10. 55	11. 90	10. 79	12. 13	11. 04	12. 35	11. 27	12. 56	11. 51	12. 77			
260	Sag	4. 03	5. 21	4. 24	5. 44	4. 45	5. 66	4. 66	5. 8	4. 87	6. 10	5. 08	6. 31	5. 30	6. 52	7. 13	8. 07	7. 23
	3 Returns	10. 88	12. 36	11. 15	12. 63	11. 42	12. 89	11. 69	13. 13	11. 96	13. 37	12. 21	13. 61	12. 47	13. 83			
280	Sag	4. 68	6. 04	4. 92	6. 31	5. 16	6. 56	5. 40	6. 82	5. 65	7. 07	5. 90	7. 32	6. 14	7. 56	8. 27	9. 36	8. 39
	3 Returns	11. 72	13. 31	12. 01	13. 60	12. 30	13. 88	12. 59	14. 14	12. 87	14. 40	13. 15	14. 65	13. 42	14. 89			
300	Sag	5. 37	6. 94	5. 64	7. 24	5. 92	7. 54	6. 20	7. 83	6. 49	8. 12	6. 77	8. 40	7. 05	8. 68	9. 49	10. 75	9. 63
	3 Returns	12. 55	14. 27	12. 87	14. 57	13. 18	14. 87	13. 49	15. 15	13. 79	15. 43	14. 09	15. 70	14. 38	15. 96			
CONDUCTOR		TENSION (kN)																
CHLORINE (7/2. 50)		1. 23	1. 06	1. 19	1. 03	1. 16	1. 01	1. 12	0. 99	1. 09	0. 96	1. 07	0. 94	1. 04	0. 92	0. 94	0. 86	
HYDROGEN (7/4. 50)		6. 26	4. 85	5. 95	4. 64	5. 68	4. 46	5. 42	4. 29	5. 18	4. 14	4. 97	4. 00	4. 77	3. 87	3. 54	3. 12	
KRYPTON (19/3. 25)		8. 72	7. 46	8. 32	7. 13	7. 95	6. 83	7. 60	6. 55	7. 28	6. 30	6. 99	6. 07	6. 72	5. 86	5. 32	4. 65	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:28ºC

ACSR (Low Steel Content)

8.3 Sheet 35 **BARE ACSR (LOW STEEL CONTENT)** **SEMI-URBAN (12% UTS) 50m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
20	Sag	0. 04	0. 05	0. 04	0. 05	0. 05	0. 06	0. 05	0. 07	0. 06	0. 08	0. 07	0. 09	0. 08	0. 10	0. 11	0. 13	0. 13
	3 Returns	1. 05	1. 16	1. 11	1. 25	1. 18	1. 35	1. 25	1. 44	1. 33	1. 53	1. 42	1. 62	1. 50	1. 70			
30	Sag	0. 08	0. 10	0. 09	0. 12	0. 11	0. 14	0. 12	0. 16	0. 14	0. 18	0. 16	0. 20	0. 17	0. 22	0. 25	0. 29	0. 29
	3 Returns	1. 57	1. 75	1. 67	1. 89	1. 77	2. 03	1. 88	2. 17	2. 01	2. 31	2. 14	2. 44	2. 26	2. 56			
40	Sag	0. 15	0. 19	0. 17	0. 22	0. 19	0. 25	0. 22	0. 29	0. 24	0. 32	0. 28	0. 36	0. 31	0. 40	0. 44	0. 52	0. 51
	3 Returns	2. 10	2. 34	2. 22	2. 52	2. 36	2. 71	2. 52	2. 90	2. 68	3. 08	2. 85	3. 25	3. 02	3. 41			
50	Sag	0. 24	0. 29	0. 26	0. 34	0. 30	0. 39	0. 34	0. 45	0. 38	0. 51	0. 43	0. 56	0. 49	0. 62	0. 70	0. 82	0. 79
	3 Returns	2. 63	2. 93	2. 78	3. 15	2. 96	3. 39	3. 15	3. 62	3. 35	3. 85	3. 57	4. 07	3. 78	4. 27			
60	Sag	0. 34	0. 42	0. 38	0. 49	0. 43	0. 57	0. 49	0. 65	0. 56	0. 74	0. 63	0. 82	0. 71	0. 90	1. 01	1. 20	1. 14
	3 Returns	3. 17	3. 53	3. 36	3. 80	3. 57	4. 09	3. 80	4. 37	4. 05	4. 65	4. 30	4. 91	4. 56	5. 15			
70	Sag	0. 47	0. 58	0. 52	0. 67	0. 59	0. 77	0. 67	0. 89	0. 76	1. 00	0. 86	1. 12	0. 96	1. 23	1. 38	1. 63	1. 56
	3 Returns	3. 70	4. 12	3. 92	4. 43	4. 16	4. 76	4. 43	5. 10	4. 72	5. 42	5. 02	5. 72	5. 32	6. 01			
80	Sag	0. 61	0. 75	0. 68	0. 87	0. 77	1. 01	0. 87	1. 16	0. 99	1. 31	1. 12	1. 46	1. 26	1. 61	1. 80	2. 13	2. 03
	3 Returns	4. 23	4. 70	4. 47	5. 06	4. 75	5. 44	5. 06	5. 82	5. 39	6. 19	5. 73	6. 54	6. 07	6. 86			
90	Sag	0. 77	0. 95	0. 86	1. 11	0. 97	1. 28	1. 10	1. 46	1. 25	1. 65	1. 42	1. 84	1. 59	2. 03	2. 28	2. 69	2. 57
	3 Returns	4. 76	5. 29	5. 03	5. 70	5. 35	6. 12	5. 69	6. 55	6. 06	6. 97	6. 45	7. 36	6. 83	7. 72			
100	Sag	0. 95	1. 18	1. 06	1. 36	1. 20	1. 58	1. 36	1. 80	1. 55	2. 04	1. 75	2. 28	1. 96	2. 51	2. 81	3. 32	3. 18
	3 Returns	5. 28	5. 88	5. 59	6. 33	5. 94	6. 80	6. 32	7. 28	6. 74	7. 74	7. 16	8. 17	7. 59	8. 58			
CONDUCTOR		TENSION (kN)																
ALMOND 6/1/2. 50		1. 47	1. 26	1. 29	1. 09	1. 13	0. 94	0. 98	0. 82	0. 85	0. 72	0. 75	0. 65	0. 67	0. 59	0. 49	0. 42	
APPLE 6/1/3. 00		2. 21	1. 79	1. 98	1. 54	1. 75	1. 33	1. 54	1. 17	1. 36	1. 03	1. 20	0. 92	1. 07	0. 84	0. 75	0. 63	
BANANA 6/1/3. 75		3. 37	2. 72	3. 00	2. 35	2. 66	2. 04	2. 34	1. 78	2. 07	1. 58	1. 83	1. 42	1. 63	1. 30	1. 16	0. 98	
CHERRY 6/4. 75 + 7/1. 60																		
LEMON 30/7/3. 00																		
LYCHEE 30/7/3. 50																		

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:11ºC

8.3 Sheet 36 **BARE ACSR (LOW STEEL CONTENT)** **SEMI-URBAN (12% UTS) 75m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0.24	0.29	0.26	0.32	0.29	0.36	0.32	0.39	0.35	0.43	0.38	0.46	0.41	0.49	0.56	0.63	0.61
	3 Returns	2.65	2.93	2.78	3.08	2.92	3.24	3.05	3.39	3.20	3.54	3.33	3.67	3.47	3.80			
60	Sag	0.35	0.42	0.38	0.47	0.42	0.52	0.46	0.56	0.50	0.61	0.55	0.66	0.59	0.71	0.80	0.91	0.88
	3 Returns	3.19	3.51	3.34	3.70	3.50	3.89	3.67	4.07	3.84	4.24	4.00	4.41	4.17	4.56			
70	Sag	0.47	0.57	0.52	0.64	0.57	0.70	0.62	0.77	0.68	0.84	0.74	0.90	0.81	0.97	1.10	1.24	1.19
	3 Returns	3.72	4.10	3.90	4.32	4.09	4.54	4.28	4.75	4.48	4.95	4.67	5.14	4.86	5.32			
80	Sag	0.62	0.75	0.68	0.83	0.74	0.92	0.82	1.01	0.89	1.09	0.97	1.18	1.05	1.26	1.43	1.62	1.56
	3 Returns	4.25	4.69	4.46	4.94	4.67	5.19	4.89	5.43	5.12	5.66	5.34	5.88	5.56	6.09			
90	Sag	0.78	0.95	0.86	1.05	0.94	1.16	1.03	1.27	1.13	1.38	1.23	1.49	1.33	1.60	1.81	2.05	1.97
	3 Returns	4.78	5.27	5.01	5.56	5.26	5.84	5.51	6.11	5.76	6.37	6.01	6.62	6.25	6.85			
100	Sag	0.97	1.18	1.06	1.31	1.17	1.44	1.28	1.58	1.40	1.72	1.53	1.85	1.66	1.99	2.25	2.55	2.43
	3 Returns	5.33	5.88	5.59	6.20	5.86	6.51	6.14	6.81	6.42	7.10	6.70	7.38	6.97	7.63			
110	Sag	1.17	1.42	1.29	1.58	1.41	1.75	1.55	1.91	1.70	2.08	1.85	2.24	2.00	2.40	2.73	3.08	2.95
	3 Returns	5.87	6.47	6.15	6.82	6.44	7.16	6.75	7.49	7.06	7.81	7.37	8.11	7.67	8.40			
120	Sag	1.39	1.69	1.53	1.88	1.68	2.08	1.85	2.28	2.02	2.48	2.20	2.67	2.38	2.86	3.24	3.67	3.51
	3 Returns	6.40	7.05	6.70	7.44	7.03	7.81	7.36	8.18	7.70	8.52	8.04	8.85	8.36	9.16			
130	Sag	1.64	1.99	1.80	2.21	1.97	2.44	2.17	2.67	2.37	2.90	2.58	3.13	2.80	3.36	3.81	4.31	4.12
	3 Returns	6.93	7.64	7.26	8.05	7.61	8.46	7.98	8.86	8.34	9.23	8.70	9.59	9.06	9.92			
140	Sag	1.90	2.31	2.08	2.56	2.29	2.83	2.51	3.10	2.75	3.37	2.99	3.63	3.24	3.89	4.42	4.49	4.77
	3 Returns	7.46	8.23	7.82	8.67	8.20	9.11	8.59	9.54	8.98	9.94	9.37	10.32	9.75	10.68			
150	Sag	2.18	2.65	2.39	2.94	2.63	3.25	2.89	3.56	3.16	3.87	3.44	4.17	3.72	4.47	5.07	5.73	5.48
	3 Returns	8.00	8.81	8.38	9.29	8.78	9.76	9.20	10.22	9.62	10.65	10.04	11.06	10.45	11.45			
CONDUCTOR		TENSION (kN)																
ALMOND 6/1/2.50		1.49	1.26	1.35	1.13	1.21	1.02	1.10	0.93	1.00	0.86	0.91	0.79	0.84	0.74	0.63	0.56	
APPLE 6/1/3.00		2.17	1.79	1.98	1.61	1.80	1.46	1.64	1.33	1.50	1.22	1.38	1.13	1.27	1.06	0.93	0.83	
BANANA 6/1/3.75		3.30	2.72	3.00	2.45	2.73	2.23	2.49	2.04	2.28	1.88	2.10	1.75	1.94	1.63	1.44	1.28	
CHERRY 6/4.75																		
LEMON 30/7/3.00																		
LYCHEE 30/7/3.50																		

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:12ºC

8.3 Sheet 37 **BARE ACSR (LOW STEEL CONTENT)** **SEMI-URBAN (12% UTS) 100m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0. 24	0. 29	0. 26	0. 31	0. 28	0. 34	0. 30	0. 36	0. 32	0. 38	0. 34	0. 41	0. 36	0. 43	0. 48	0. 53	0. 51
	3 Returns	2. 65	2. 93	2. 75	3. 04	2. 85	3. 15	2. 96	3. 26	3. 06	3. 36	3. 16	3. 45	3. 26	3. 54			
60	Sag	0. 34	0. 42	0. 37	0. 45	0. 40	0. 49	0. 43	0. 52	0. 46	0. 55	0. 49	0. 59	0. 52	0. 62	0. 70	0. 77	0. 74
	3 Returns	3. 18	3. 51	3. 30	3. 65	3. 42	3. 78	3. 55	3. 91	3. 67	4. 03	3. 79	4. 15	3. 91	4. 25			
80	Sag	0. 61	0. 75	0. 66	0. 81	0. 71	0. 87	0. 76	0. 93	0. 82	0. 99	0. 87	1. 04	0. 93	1. 10	1. 24	1. 37	1. 31
	3 Returns	4. 24	4. 69	4. 40	4. 87	4. 57	5. 05	4. 73	5. 22	4. 90	5. 38	5. 06	5. 53	5. 22	5. 68			
100	Sag	0. 96	1. 17	1. 03	1. 26	1. 11	1. 36	1. 19	1. 45	1. 28	1. 54	1. 36	1. 63	1. 45	1. 72	1. 94	2. 14	2. 05
	3 Returns	5. 30	5. 86	5. 51	6. 09	5. 71	6. 31	5. 92	6. 52	6. 13	6. 72	6. 33	6. 92	6. 52	7. 10			
120	Sag	1. 39	1. 70	1. 50	1. 83	1. 61	1. 97	1. 73	2. 10	1. 85	2. 23	1. 97	2. 36	2. 10	2. 49	2. 81	3. 10	2. 95
	3 Returns	6. 38	7. 05	6. 63	7. 33	6. 87	7. 59	7. 12	7. 85	7. 37	8. 09	7. 61	8. 32	7. 85	8. 54			
140	Sag	1. 89	2. 31	2. 04	2. 49	2. 19	2. 67	2. 35	2. 86	2. 52	3. 04	2. 69	3. 21	2. 86	3. 38	3. 83	4. 22	4. 02
	3 Returns	7. 44	8. 23	7. 73	8. 55	8. 02	8. 86	8. 31	9. 16	8. 60	9. 44	8. 88	9. 71	9. 15	9. 96			
160	Sag	2. 46	3. 01	2. 66	3. 25	2. 86	3. 49	3. 07	3. 73	3. 29	3. 97	3. 51	4. 19	3. 73	4. 42	5. 00	5. 51	5. 26
	3 Returns	8. 50	9. 40	8. 83	9. 77	9. 16	10. 12	9. 50	10. 46	9. 83	10. 79	10. 15	11. 09	10. 46	11. 38			
180	Sag	3. 12	3. 81	3. 36	4. 12	3. 62	4. 42	3. 89	4. 72	4. 16	5. 02	4. 44	5. 31	4. 72	5. 59	6. 33	6. 97	6. 65
	3 Returns	9. 57	10. 58	9. 93	10. 99	10. 31	11. 39	10. 68	11. 77	11. 05	12. 13	11. 41	12. 48	11. 77	12. 81			
200	Sag	3. 85	4. 71	4. 15	5. 08	4. 47	5. 46	4. 80	5. 83	5. 14	6. 20	5. 48	6. 56	5. 83	6. 91	7. 81	8. 61	8. 22
	3 Returns	10. 63	11. 75	11. 04	12. 21	11. 45	12. 65	11. 87	13. 08	12. 28	13. 48	12. 68	13. 86	13. 07	14. 23			
CONDUCTOR		TENSION (kN)																
ALMOND 6/1/2. 50		1. 52	1. 26	1. 40	1. 16	1. 30	1. 08	1. 20	1. 01	1. 12	0. 95	1. 04	0. 90	0. 98	0. 85	0. 74	0. 67	
APPLE 6/1/3. 00		2. 18	1. 79	2. 02	1. 65	1. 88	1. 54	1. 75	1. 44	1. 64	1. 36	1. 53	1. 28	1. 44	1. 22	1. 07	0. 98	
BANANA 6/1/3. 75		3. 19	2. 72	2. 96	2. 53	2. 76	2. 36	2. 58	2. 21	2. 42	2. 08	2. 27	1. 97	2. 15	1. 88	1. 67	1. 51	
CHERRY 6/4. 75																		
LEMON 30/7/3. 00																		
LYCHEE 30/7/3. 50																		

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:14ºC

8.3 Sheet 38 **BARE ACSR (LOW STEEL CONTENT)** **SEMI-URBAN (12% UTS) 150m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
80	Sag	0. 62	0. 75	0. 65	0. 78	0. 68	0. 82	0. 71	0. 85	0. 75	0. 88	0. 78	0. 91	0. 81	0. 94	1. 03	1. 12	1. 06
	3 Returns	4. 27	4. 69	4. 37	4. 79	4. 48	4. 89	4. 58	4. 99	4. 68	5. 08	4. 77	5. 17	4. 87	5. 25			
100	Sag	0. 97	1. 17	1. 02	1. 22	1. 07	1. 28	1. 12	1. 33	1. 17	1. 38	1. 21	1. 42	1. 26	1. 47	1. 61	1. 74	1. 66
	3 Returns	5. 34	5. 87	5. 47	6. 00	5. 60	6. 12	5. 73	6. 24	5. 85	6. 35	5. 97	6. 46	6. 09	6. 57			
120	Sag	1. 40	1. 69	1. 47	1. 76	1. 54	1. 84	1. 61	1. 91	1. 68	1. 98	1. 75	2. 05	1. 82	2. 12	2. 32	2. 51	2. 40
	3 Returns	6. 41	7. 04	6. 57	7. 20	6. 72	7. 34	6. 87	7. 49	7. 02	7. 63	7. 17	7. 76	7. 31	7. 89			
140	Sag	1. 90	2. 30	2. 00	2. 40	2. 10	2. 50	2. 19	2. 60	2. 29	2. 70	2. 38	2. 79	2. 48	2. 89	3. 15	3. 42	3. 26
	3 Returns	7. 48	8. 22	7. 66	8. 40	7. 84	8. 57	8. 02	8. 74	8. 19	8. 90	8. 36	9. 05	8. 52	9. 20			
160	Sag	2. 49	3. 01	2. 61	3. 14	2. 74	3. 27	2. 86	3. 40	2. 99	3. 53	3. 11	3. 65	3. 24	3. 77	4. 12	4. 47	4. 26
	3 Returns	8. 55	9. 39	8. 76	9. 60	8. 96	9. 80	9. 17	9. 99	9. 36	10. 17	9. 56	10. 35	9. 74	10. 52			
180	Sag	3. 16	3. 82	3. 32	3. 99	3. 48	4. 16	3. 64	4. 32	3. 80	4. 48	3. 95	4. 64	4. 11	4. 79	5. 24	5. 69	5. 40
	3 Returns	9. 63	10. 58	9. 87	10. 82	10. 10	11. 04	10. 33	11. 26	10. 55	11. 46	10. 77	11. 66	10. 98	11. 85			
200	Sag	3. 90	4. 71	4. 10	4. 92	4. 29	5. 13	4. 49	5. 33	4. 69	5. 53	4. 88	5. 72	5. 07	5. 92	6. 47	7. 02	6. 66
	3 Returns	10. 70	11. 76	10. 97	12. 02	11. 22	12. 27	11. 48	12. 51	11. 73	12. 74	11. 97	12. 96	12. 20	13. 17			
220	Sag	4. 72	5. 70	4. 96	5. 96	5. 20	6. 21	5. 43	6. 45	5. 67	6. 69	5. 91	6. 93	6. 14	7. 16	7. 82	8. 50	8. 07
	3 Returns	11. 77	12. 93	12. 06	13. 22	12. 35	13. 49	12. 63	13. 75	12. 90	14. 01	13. 16	14. 25	13. 42	14. 49			
240	Sag	5. 62	6. 79	5. 90	7. 09	6. 18	7. 39	6. 47	7. 68	6. 75	7. 97	7. 03	8. 25	7. 31	8. 52	9. 31	10. 11	9. 60
	3 Returns	12. 84	14. 11	13. 16	14. 42	13. 47	14. 72	13. 77	15. 00	14. 07	15. 28	14. 36	15. 55	14. 64	15. 80			
260	Sag	6. 60	7. 97	6. 93	8. 32	7. 26	8. 67	7. 59	9. 01	7. 92	9. 35	8. 25	9. 68	8. 58	10. 00	10. 93	11. 87	11. 27
	3 Returns	13. 91	15. 28	14. 25	15. 62	14. 59	15. 94	14. 92	16. 25	15. 24	16. 55	15. 55	16. 84	15. 86	17. 12			
280	Sag	7. 65	9. 24	8. 03	9. 65	8. 42	10. 06	8. 80	10. 46	9. 19	10. 85	9. 57	11. 23	9. 95	11. 60	12. 68	13. 77	13. 08
	3 Returns	14. 98	16. 46	15. 35	16. 82	15. 71	17. 17	16. 07	17. 50	16. 41	17. 83	16. 75	18. 14	17. 08	18. 43			
300	Sag	8. 78	10. 61	9. 22	11. 08	9. 66	11. 55	10. 11	12. 00	10. 55	12. 45	10. 99	12. 89	11. 42	13. 32	14. 57	15. 82	15. 02
	3 Returns	16. 05	17. 63	16. 44	18. 02	16. 83	18. 39	17. 21	18. 75	17. 58	19. 10	17. 95	19. 43	18. 30	19. 75			
CONDUCTOR		TENSION (kN)																
ALMOND 6/1/2. 50		1. 52	1. 26	1. 44	1. 20	1. 37	1. 15	1. 31	1. 11	1. 25	1. 07	1. 20	1. 03	1. 15	1. 00	0. 91	0. 83	
APPLE 6/1/3. 00		2. 15	1. 78	2. 05	1. 71	1. 96	1. 64	1. 87	1. 58	1. 79	1. 52	1. 72	1. 47	1. 66	1. 42	1. 30	1. 20	
BANANA 6/1/3. 75		3. 08	2. 72	2. 94	2. 61	2. 82	2. 50	2. 71	2. 41	2. 60	2. 33	2. 51	2. 25	2. 42	2. 18	2. 00	1. 85	
CHERRY 6/4. 75																		
LEMON 30/7/3. 00																		
LYCHEE 30/7/3. 50																		

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC:21ºC

8.3 Sheet 39 BARE ACSR (LOW STEEL CONTENT) RURAL (22. 5% UTS) 100m RULING SPAN

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
60	Sag	0. 18	0. 22	0. 19	0. 25	0. 20	0. 27	0. 21	0. 29	0. 23	0. 32	0. 24	0. 35	0. 26	0. 39	0. 49	0. 56	0. 59
	3 Returns	2. 29	2. 57	2. 35	2. 68	2. 42	2. 81	2. 50	2. 94	2. 58	3. 08	2. 68	3. 22	2. 78	3. 37			
70	Sag	0. 24	0. 31	0. 26	0. 33	0. 27	0. 37	0. 29	0. 40	0. 31	0. 44	0. 33	0. 48	0. 36	0. 53	0. 66	0. 76	0. 80
	3 Returns	2. 67	2. 99	2. 75	3. 13	2. 83	3. 28	2. 92	3. 43	3. 02	3. 60	3. 12	3. 76	3. 24	3. 93			
80	Sag	0. 32	0. 40	0. 34	0. 44	0. 36	0. 48	0. 38	0. 53	0. 40	0. 58	0. 43	0. 63	0. 47	0. 69	0. 87	0. 99	1. 04
	3 Returns	3. 05	3. 42	3. 14	3. 58	3. 23	3. 75	3. 34	3. 93	3. 45	4. 11	3. 57	4. 30	3. 70	4. 49			
90	Sag	0. 40	0. 51	0. 42	0. 55	0. 45	0. 61	0. 48	0. 66	0. 51	0. 73	0. 55	0. 80	0. 59	0. 87	1. 10	1. 26	1. 32
	3 Returns	3. 44	3. 85	3. 53	4. 03	3. 64	4. 22	3. 75	4. 42	3. 88	4. 63	4. 02	4. 84	4. 17	5. 05			
100	Sag	0. 50	0. 62	0. 52	0. 68	0. 56	0. 75	0. 59	0. 82	0. 63	0. 90	0. 68	0. 99	0. 73	1. 07	1. 35	1. 55	1. 63
	3 Returns	3. 82	4. 28	3. 93	4. 48	4. 04	4. 69	4. 17	4. 91	4. 31	5. 14	4. 46	5. 38	4. 63	5. 62			
110	Sag	0. 60	0. 76	0. 64	0. 83	0. 67	0. 91	0. 72	0. 99	0. 77	1. 09	0. 82	1. 19	0. 88	1. 30	1. 64	1. 88	1. 97
	3 Returns	4. 20	4. 71	4. 32	4. 92	4. 45	5. 16	4. 59	5. 40	4. 74	5. 66	4. 91	5. 92	5. 09	6. 18			
120	Sag	0. 72	0. 90	0. 76	0. 98	0. 80	1. 08	0. 85	1. 18	0. 91	1. 30	0. 98	1. 42	1. 05	1. 55	1. 95	2. 24	2. 35
	3 Returns	4. 58	5. 14	4. 71	5. 37	4. 85	5. 62	5. 01	5. 89	5. 18	6. 17	5. 36	6. 46	5. 56	6. 74			
130	Sag	0. 84	1. 06	0. 89	1. 16	0. 95	1. 27	1. 01	1. 40	1. 08	1. 53	1. 15	1. 67	1. 24	1. 83	2. 30	2. 64	2. 75
	3 Returns	4. 98	5. 58	5. 12	5. 83	5. 27	6. 11	5. 44	6. 40	5. 62	6. 70	5. 82	7. 01	6. 04	7. 32			
140	Sag	0. 98	1. 23	1. 03	1. 34	1. 10	1. 47	1. 17	1. 62	1. 25	1. 77	1. 34	1. 94	1. 44	2. 12	2. 67	3. 06	3. 19
	3 Returns	5. 36	6. 01	5. 51	6. 28	5. 67	6. 58	5. 86	6. 89	6. 05	7. 22	6. 27	7. 55	6. 50	7. 88			
150	Sag	1. 12	1. 41	1. 19	1. 54	1. 26	1. 69	1. 34	1. 86	1. 43	2. 04	1. 54	2. 23	1. 65	2. 43	3. 06	3. 51	3. 67
	3 Returns	5. 74	6. 44	5. 90	6. 73	6. 08	7. 05	6. 27	7. 38	6. 48	7. 73	6. 71	8. 09	6. 96	8. 45			
160	Sag	1. 28	1. 61	1. 35	1. 76	1. 43	1. 92	1. 52	2. 11	1. 63	2. 32	1. 75	2. 54	1. 88	2. 77	3. 48	3. 99	4. 17
	3 Returns	6. 12	6. 86	6. 30	7. 18	6. 48	7. 52	6. 69	7. 87	6. 92	8. 25	7. 16	8. 63	7. 43	9. 01			
170	Sag	1. 44	1. 81	1. 52	1. 98	1. 62	2. 17	1. 72	2. 38	1. 84	2. 62	1. 97	2. 86	2. 12	3. 12	3. 93	4. 51	4. 71
	3 Returns	6. 51	7. 29	6. 69	7. 63	6. 89	7. 99	7. 11	8. 37	7. 35	8. 76	7. 61	9. 17	7. 89	9. 57			
180	Sag	1. 62	2. 03	1. 71	2. 22	1. 81	2. 44	1. 93	2. 67	2. 06	2. 93	2. 21	3. 21	2. 38	3. 50	4. 41	5. 05	5. 28
	3 Returns	6. 89	7. 72	7. 08	8. 08	7. 29	8. 46	7. 53	8. 86	7. 78	9. 28	8. 05	9. 71	8. 35	10. 13			
CONDUCTOR		TENSION (kN)																
ALMOND 6/1/2. 50		3. 19	2. 36	3. 01	2. 16	2. 84	1. 97	2. 66	1. 79	2. 48	1. 63	2. 30	1. 49	2. 13	1. 36	1. 10	0. 96	
APPLE 6/1/3. 00		4. 21	3. 35	3. 98	3. 06	3. 76	2. 79	3. 53	2. 55	3. 30	2. 32	3. 08	2. 12	2. 86	1. 95	1. 54	1. 38	
BANANA 6/1/3. 75		6. 41	5. 11	6. 05	4. 66	5. 70	4. 25	5. 34	3. 88	4. 99	3. 54	4. 65	3. 24	4. 32	2. 97	2. 37	2. 07	
CHERRY 6/4. 75																		
LEMON 30/7/3. 00																		
LYCHEE 30/7/3. 50																		

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC:20ºC

8.3 Sheet 40 **BARE ACSR (LOW STEEL CONTENT)** **RURAL (22. 5% UTS)** **150m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
SPAN LENGTH (m)	ELEMENT	5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
80	Sag	0. 30	0. 40	0. 32	0. 43	0. 34	0. 46	0. 35	0. 49	0. 37	0. 53	0. 39	0. 56	0. 42	0. 59	0. 70	0. 81	0. 83
	3 Returns	2. 99	3. 42	3. 06	3. 55	3. 14	3. 67	3. 22	3. 80	3. 31	3. 93	3. 40	4. 05	3. 50	4. 17			
100	Sag	0. 48	0. 62	0. 50	0. 67	0. 52	0. 72	0. 55	0. 77	0. 58	0. 82	0. 62	0. 87	0. 65	0. 93	1. 09	1. 27	1. 30
	3 Returns	3. 74	4. 28	3. 83	4. 43	3. 92	4. 59	4. 03	4. 75	4. 14	4. 91	4. 26	5. 07	4. 38	5. 22			
120	Sag	0. 68	0. 90	0. 72	0. 97	0. 76	1. 03	0. 80	1. 11	0. 84	1. 18	0. 89	1. 26	0. 94	1. 34	1. 57	1. 83	1. 87
	3 Returns	4. 48	5. 14	4. 59	5. 32	4. 71	5. 51	4. 84	5. 70	4. 97	5. 89	5. 11	6. 08	5. 26	6. 27			
140	Sag	0. 93	1. 22	0. 98	1. 31	1. 03	1. 41	1. 08	1. 51	1. 14	1. 61	1. 21	1. 72	1. 28	1. 82	2. 14	2. 49	2. 54
	3 Returns	5. 23	6. 00	5. 36	6. 21	5. 50	6. 43	5. 64	6. 65	5. 80	6. 88	5. 96	7. 10	6. 13	7. 31			
160	Sag	1. 22	1. 60	1. 28	1. 72	1. 34	1. 84	1. 42	1. 97	1. 49	2. 10	1. 58	2. 24	1. 67	2. 38	2. 79	3. 25	3. 32
	3 Returns	5. 98	6. 85	6. 12	7. 10	6. 28	7. 35	6. 45	7. 60	6. 62	7. 86	6. 81	8. 11	7. 00	8. 35			
180	Sag	1. 54	2. 03	1. 62	2. 17	1. 70	2. 33	1. 79	2. 49	1. 89	2. 66	2. 00	2. 84	2. 12	3. 01	3. 54	4. 12	4. 21
	3 Returns	6. 73	7. 71	6. 89	7. 99	7. 07	8. 27	7. 26	8. 56	7. 46	8. 84	7. 67	9. 13	7. 89	9. 40			
200	Sag	1. 91	2. 51	2. 00	2. 69	2. 11	2. 89	2. 22	3. 09	2. 35	3. 30	2. 48	3. 51	2. 62	3. 73	4. 39	5. 11	5. 19
	3 Returns	7. 49	8. 58	7. 67	8. 89	7. 87	9. 20	8. 08	9. 52	8. 30	9. 84	8. 53	10. 16	8. 78	10. 47			
220	Sag	2. 31	3. 03	2. 42	3. 26	2. 55	3. 49	2. 68	3. 74	2. 83	3. 99	3. 00	4. 25	3. 17	4. 51	5. 30	6. 17	6. 29
	3 Returns	8. 23	9. 44	8. 43	9. 78	8. 65	10. 12	8. 88	10. 47	9. 12	10. 82	9. 38	11. 16	9. 65	11. 50			
240	Sag	2. 75	3. 61	2. 89	3. 88	3. 04	4. 16	3. 20	4. 45	3. 38	4. 75	3. 57	5. 06	3. 78	5. 37	6. 32	7. 36	7. 48
	3 Returns	8. 98	10. 30	9. 20	10. 67	9. 44	11. 04	9. 69	11. 43	9. 96	11. 81	10. 24	12. 19	10. 53	12. 56			
260	Sag	3. 23	4. 24	3. 39	4. 55	3. 56	4. 88	3. 75	5. 22	3. 96	5. 58	4. 19	5. 94	4. 43	6. 31	7. 41	8. 63	8. 78
	3 Returns	9. 73	11. 15	9. 97	11. 55	10. 23	11. 96	10. 50	12. 38	10. 78	12. 79	11. 09	13. 20	11. 41	13. 60			
280	Sag	3. 74	4. 92	3. 93	5. 28	4. 13	5. 66	4. 35	6. 06	4. 60	6. 47	4. 86	6. 89	5. 14	7. 32	8. 60	10. 01	10. 19
	3 Returns	10. 48	12. 01	10. 74	12. 44	11. 01	12. 88	11. 30	13. 33	11. 61	13. 77	11. 94	14. 22	12. 28	14. 65			
300	Sag	4. 30	5. 64	4. 51	6. 06	4. 74	6. 49	5. 00	6. 95	5. 28	7. 42	5. 58	7. 91	5. 90	8. 40	9. 87	11. 50	11. 70
	3 Returns	11. 23	12. 87	11. 50	13. 33	11. 80	13. 80	12. 11	14. 28	12. 44	14. 76	12. 79	15. 23	13. 16	15. 69			
CONDUCTOR		TENSION (kN)																
ALMOND 6/1/2. 50		3. 19	2. 36	3. 03	2. 20	2. 87	2. 05	2. 71	1. 91	2. 56	1. 79	2. 41	1. 68	2. 26	1. 58	1. 34	1. 17	
APPLE 6/1/3. 00		4. 40	3. 35	4. 19	3. 12	3. 99	2. 91	3. 78	2. 72	3. 58	2. 55	3. 39	2. 39	3. 20	2. 25	1. 91	1. 64	
BANANA 6/1/3. 75		6. 32	5. 10	6. 01	4. 76	5. 70	4. 44	5. 39	4. 15	5. 10	3. 89	4. 82	3. 66	4. 55	3. 45	2. 94	2. 53	
CHERRY 6/4. 75																		
LEMON 30/7/3. 00																		
LYCHEE 30/7/3. 50																		

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:26ºC

8.3 Sheet 41 **BARE ACSR (LOW STEEL CONTENT)** **RURAL (22. 5% UTS)** **200m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
100	Sag	0. 44	0. 62	0. 46	0. 66	0. 48	0. 70	0. 50	0. 73	0. 53	0. 77	0. 55	0. 81	0. 58	0. 84	0. 95	1. 11	1. 11
	3 Returns	3. 61	4. 28	3. 69	4. 40	3. 77	4. 52	3. 85	4. 64	3. 94	4. 75	4. 03	4. 86	4. 12	4. 98			
120	Sag	0. 64	0. 90	0. 67	0. 95	0. 70	1. 00	0. 73	1. 06	0. 76	1. 11	0. 80	1. 16	0. 83	1. 21	1. 37	1. 60	1. 60
	3 Returns	4. 33	5. 14	4. 42	5. 28	4. 52	5. 42	4. 62	5. 57	4. 72	5. 70	4. 83	5. 84	4. 94	5. 97			
140	Sag	0. 87	1. 23	0. 91	1. 29	0. 95	1. 36	0. 99	1. 44	1. 03	1. 51	1. 08	1. 58	1. 13	1. 65	1. 87	2. 17	2. 18
	3 Returns	5. 06	6. 00	5. 16	6. 16	5. 27	6. 33	5. 39	6. 49	5. 51	6. 66	5. 64	6. 81	5. 77	6. 97			
160	Sag	1. 14	1. 60	1. 19	1. 69	1. 24	1. 78	1. 29	1. 88	1. 35	1. 97	1. 42	2. 07	1. 48	2. 16	2. 44	2. 84	2. 85
	3 Returns	5. 78	6. 85	5. 90	7. 05	6. 03	7. 23	6. 16	7. 42	6. 30	7. 61	6. 45	7. 79	6. 60	7. 96			
180	Sag	1. 44	2. 03	1. 50	2. 14	1. 57	2. 26	1. 64	2. 38	1. 71	2. 50	1. 79	2. 62	1. 88	2. 74	3. 09	3. 60	3. 61
	3 Returns	6. 50	7. 71	6. 64	7. 93	6. 78	8. 14	6. 93	8. 35	7. 09	8. 56	7. 25	8. 76	7. 42	8. 96			
200	Sag	1. 78	2. 51	1. 86	2. 65	1. 94	2. 80	2. 03	2. 94	2. 12	3. 09	2. 22	3. 24	2. 32	3. 39	3. 83	4. 45	4. 46
	3 Returns	7. 24	8. 58	7. 39	8. 82	7. 55	9. 06	7. 71	9. 29	7. 89	9. 53	8. 07	9. 75	8. 26	9. 97			
220	Sag	2. 16	3. 04	2. 25	3. 21	2. 35	3. 38	2. 45	3. 56	2. 56	3. 74	2. 68	3. 92	2. 81	4. 10	4. 63	5. 39	5. 40
	3 Returns	7. 96	9. 44	8. 13	9. 70	8. 30	9. 96	8. 49	10. 22	8. 68	10. 48	8. 88	10. 73	9. 08	10. 97			
240	Sag	2. 57	3. 61	2. 68	3. 82	2. 79	4. 03	2. 92	4. 24	3. 05	4. 45	3. 19	4. 67	3. 34	4. 88	5. 51	6. 41	6. 42
	3 Returns	8. 68	10. 30	8. 87	10. 58	9. 06	10. 87	9. 26	11. 15	9. 47	11. 43	9. 68	11. 70	9. 91	11. 97			
260	Sag	3. 01	4. 24	3. 14	4. 48	3. 28	4. 72	3. 43	4. 97	3. 58	5. 22	3. 75	5. 48	3. 93	5. 73	6. 47	7. 53	7. 54
	3 Returns	9. 41	11. 16	9. 60	11. 47	9. 81	11. 77	10. 03	12. 08	10. 25	12. 38	10. 49	12. 68	10. 73	12. 96			
280	Sag	3. 50	4. 92	3. 64	5. 20	3. 80	5. 48	3. 97	5. 77	4. 15	6. 06	4. 35	6. 35	4. 55	6. 64	7. 51	8. 73	8. 75
	3 Returns	10. 13	12. 01	10. 34	12. 35	10. 56	12. 68	10. 80	13. 01	11. 04	13. 33	11. 30	13. 65	11. 56	13. 96			
300	Sag	4. 01	5. 65	4. 18	5. 96	4. 36	6. 29	4. 56	6. 62	4. 77	6. 96	4. 99	7. 29	5. 23	7. 63	8. 62	10. 03	10. 04
	3 Returns	10. 85	12. 87	11. 08	13. 23	11. 32	13. 59	11. 57	13. 94	11. 83	14. 28	12. 10	14. 62	12. 38	14. 96			
CONDUCTOR		TENSION (kN)																
ALMOND 6/1/2. 50		3. 51	2. 36	3. 36	2. 23	3. 22	2. 11	3. 07	2. 01	2. 93	1. 91	2. 79	1. 82	2. 65	1. 74	1. 53	1. 34	
APPLE 6/1/3. 00		4. 71	3. 35	4. 52	3. 17	4. 33	3. 01	4. 14	2. 86	3. 96	2. 72	3. 79	2. 59	3. 62	2. 48	2. 19	1. 88	
BANANA 6/1/3. 75		6. 49	5. 10	6. 21	4. 83	5. 93	4. 59	5. 67	4. 36	5. 42	4. 16	5. 17	3. 97	4. 94	3. 80	3. 37	2. 91	
CHERRY 6/4. 75																		
LEMON 30/7/3. 00																		
LYCHEE 30/7/3. 50																		

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:37ºC

8.3 Sheet 42 **BARE ACSR (LOW STEEL CONTENT)** **RURAL (22. 5% UTS)** **250m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
120	Sag	0. 61	0. 90	0. 63	0. 94	0. 66	0. 98	0. 68	1. 02	0. 71	1. 06	0. 74	1. 10	0. 76	1. 14	1. 25	1. 43	1. 44
	3 Returns	4. 23	5. 14	4. 31	5. 25	4. 39	5. 36	4. 47	5. 47	4. 56	5. 57	4. 65	5. 78	4. 74	5. 87			
140	Sag	0. 83	1. 23	0. 86	1. 28	0. 89	1. 33	0. 93	1. 39	0. 96	1. 44	1. 00	1. 49	1. 04	1. 55	1. 70	1. 95	1. 95
	3 Returns	4. 94	6. 00	5. 03	6. 13	5. 12	6. 26	5. 22	6. 38	5. 32	6. 50	5. 42	6. 62	5. 53	6. 74			
160	Sag	1. 08	1. 60	1. 12	1. 67	1. 17	1. 74	1. 21	1. 81	1. 26	1. 88	1. 31	1. 95	1. 36	2. 02	2. 23	2. 55	2. 55
	3 Returns	5. 64	6. 86	5. 75	7. 01	5. 85	7. 15	5. 96	7. 29	6. 08	7. 43	6. 20	7. 57	6. 32	7. 71			
180	Sag	1. 37	2. 03	1. 42	2. 12	1. 48	2. 21	1. 53	2. 29	1. 59	2. 38	1. 66	2. 47	1. 72	2. 56	2. 82	3. 23	3. 23
	3 Returns	6. 35	7. 71	6. 46	7. 88	6. 59	8. 05	6. 71	8. 21	6. 84	8. 36	6. 97	8. 52	7. 11	8. 67			
200	Sag	1. 70	2. 51	1. 76	2. 62	1. 83	2. 73	1. 90	2. 84	1. 97	2. 95	2. 05	3. 06	2. 13	3. 17	3. 49	4. 00	3. 99
	3 Returns	7. 07	8. 59	7. 19	8. 77	7. 33	8. 95	7. 47	9. 13	7. 61	9. 31	7. 76	9. 48	7. 91	9. 65			
220	Sag	2. 06	3. 04	2. 13	3. 17	2. 21	3. 31	2. 30	3. 44	2. 39	3. 57	2. 48	3. 71	2. 58	3. 84	4. 23	4. 84	4. 83
	3 Returns	7. 77	9. 44	7. 91	9. 65	8. 06	9. 85	8. 21	10. 05	8. 37	10. 24	8. 54	10. 43	8. 70	10. 61			
240	Sag	2. 45	3. 62	2. 54	3. 77	2. 63	3. 93	2. 74	4. 09	2. 84	4. 25	2. 95	4. 41	3. 07	4. 57	5. 03	5. 76	5. 75
	3 Returns	8. 48	10. 30	8. 63	10. 52	8. 79	10. 74	8. 96	10. 96	9. 13	11. 17	9. 31	11. 38	9. 49	11. 58			
260	Sag	2. 87	4. 24	2. 98	4. 43	3. 09	4. 62	3. 21	4. 80	3. 34	4. 99	3. 47	5. 17	3. 60	5. 36	5. 90	6. 76	6. 75
	3 Returns	9. 18	11. 16	9. 35	11. 40	9. 53	11. 64	9. 71	11. 87	9. 89	12. 10	10. 09	12. 32	10. 28	12. 54			
280	Sag	3. 33	4. 92	3. 46	5. 14	3. 59	5. 35	3. 72	5. 57	3. 87	5. 79	4. 02	6. 00	4. 18	6. 22	6. 84	7. 84	7. 83
	3 Returns	9. 89	12. 02	10. 07	12. 28	10. 26	12. 53	10. 45	12. 78	10. 65	13. 03	10. 86	13. 27	11. 07	13. 50			
300	Sag	3. 83	5. 65	3. 97	5. 90	4. 12	6. 15	4. 27	6. 39	4. 44	6. 64	4. 61	6. 89	4. 80	7. 14	7. 86	9. 00	8. 99
	3 Returns	10. 60	12. 88	10. 79	13. 15	10. 99	13. 43	11. 20	13. 70	11. 42	13. 96	11. 64	14. 22	11. 86	14. 47			
		TENSION (kN)																
ALMOND 6/1/2. 50		2. 96	2. 36	2. 84	2. 26	2. 73	2. 16	2. 62	2. 08	2. 51	2. 00	2. 41	1. 93	2. 32	1. 86	1. 68	1. 48	
APPLE 6/1/3. 00		4. 94	3. 35	4. 76	3. 21	4. 59	3. 08	4. 42	2. 96	4. 26	2. 85	4. 10	2. 74	3. 94	2. 65	2. 40	2. 10	
BANANA 6/1/3. 75		6. 64	5. 10	6. 39	4. 89	6. 15	4. 70	5. 92	4. 52	5. 70	4. 35	5. 49	4. 20	5. 28	4. 06	3. 69	3. 24	
CHERRY 6/4. 75																		
LEMON 30/7/3. 00																		
LYCHEE 30/7/3. 50																		

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:47ºC

ACSR (High Steel Content)

8.3 Sheet 43 **BARE ACSR (HIGH STEEL CONTENT)** **SEMI-URBAN (12% UTS)** **50m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
20	Sag	0. 03	0. 03	0. 03	0. 04	0. 04	0. 04	0. 04	0. 04	0. 05	0. 05	0. 05	0. 05	0. 06	0. 06	0. 07	0. 10	0. 09
	3 Returns	0. 96	0. 97	1. 01	1. 01	1. 05	1. 06	1. 10	1. 11	1. 15	1. 17	1. 21	1. 23	1. 27	1. 29			
30	Sag	0. 07	0. 07	0. 08	0. 08	0. 08	0. 09	0. 09	0. 10	0. 10	0. 11	0. 11	0. 12	0. 12	0. 13	0. 17	0. 23	0. 19
	3 Returns	1. 45	1. 46	1. 51	1. 53	1. 58	1. 60	1. 65	1. 67	1. 73	1. 76	1. 82	1. 85	1. 91	1. 94			
40	Sag	0. 13	0. 13	0. 14	0. 14	0. 15	0. 16	0. 17	0. 17	0. 19	0. 19	0. 21	0. 21	0. 23	0. 24	0. 32	0. 45	0. 34
	3 Returns	1. 94	1. 95	2. 02	2. 04	2. 12	2. 14	2. 22	2. 25	2. 34	2. 37	2. 47	2. 50	2. 60	2. 64			
50	Sag	0. 20	0. 20	0. 22	0. 22	0. 24	0. 24	0. 26	0. 27	0. 29	0. 29	0. 32	0. 32	0. 35	0. 36	0. 47	0. 64	0. 53
	3 Returns	2. 42	2. 44	2. 52	2. 55	2. 64	2. 67	2. 76	2. 80	2. 90	2. 94	3. 04	3. 09	3. 20	3. 24			
60	Sag	0. 29	0. 30	0. 32	0. 32	0. 35	0. 35	0. 38	0. 39	0. 42	0. 43	0. 46	0. 47	0. 51	0. 52	0. 69	0. 93	0. 77
	3 Returns	2. 92	2. 95	3. 05	3. 08	3. 18	3. 22	3. 33	3. 37	3. 49	3. 54	3. 67	3. 72	3. 86	3. 91			
70	Sag	0. 40	0. 40	0. 43	0. 44	0. 47	0. 48	0. 51	0. 53	0. 57	0. 58	0. 62	0. 64	0. 69	0. 71	0. 93	1. 27	1. 04
	3 Returns	3. 41	3. 44	3. 55	3. 59	3. 71	3. 75	3. 89	3. 94	4. 08	4. 13	4. 28	4. 34	4. 50	4. 56			
80	Sag	0. 52	0. 52	0. 56	0. 57	0. 62	0. 63	0. 68	0. 70	0. 75	0. 77	0. 84	0. 86	0. 93	0. 96	1. 30	1. 82	1. 36
	3 Returns	3. 90	3. 93	4. 07	4. 10	4. 26	4. 30	4. 47	4. 52	4. 70	4. 77	4. 96	5. 03	5. 24	5. 31			
90	Sag	0. 65	0. 66	0. 71	0. 72	0. 78	0. 79	0. 85	0. 87	0. 93	0. 96	1. 03	1. 06	1. 14	1. 17	1. 54	2. 09	1. 72
	3 Returns	4. 38	4. 41	4. 57	4. 61	4. 77	4. 82	4. 99	5. 06	5. 24	5. 31	5. 50	5. 58	5. 78	5. 86			
100	Sag	0. 81	0. 82	0. 88	0. 89	0. 96	0. 98	1. 05	1. 08	1. 15	1. 19	1. 27	1. 31	1. 40	1. 45	1. 90	2. 58	2. 13
	3 Returns	4. 87	4. 90	5. 07	5. 12	5. 30	5. 36	5. 55	5. 62	5. 82	5. 90	6. 11	6. 20	6. 42	6. 51			
CONDUCTOR		TENSION (kN)																
QUINCE 3/4/1. 75		1. 56	1. 52	1. 44	1. 40	1. 33	1. 29	1. 22	1. 17	1. 11	1. 07	1. 01	0. 97	0. 91	0. 87	0. 66	0. 47	
RAISIN 3/4/2. 50		2. 97	2. 93	2. 74	2. 69	2. 51	2. 45	2. 29	2. 23	2. 08	2. 02	1. 89	1. 83	1. 71	1. 66	1. 26	0. 93	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:1ºC

8.3 Sheet 44 **BARE ACSR (HIGH STEEL CONTENT)** **SEMI-URBAN (12% UTS)** **75m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0. 20	0. 20	0. 21	0. 22	0. 23	0. 24	0. 25	0. 25	0. 27	0. 27	0. 29	0. 30	0. 31	0. 32	0. 39	0. 49	0. 43
	3 Returns	2. 41	2. 44	2. 50	2. 53	2. 59	2. 63	2. 69	2. 73	2. 79	2. 84	2. 90	2. 94	3. 01	3. 05			
60	Sag	0. 29	0. 29	0. 31	0. 32	0. 33	0. 34	0. 36	0. 37	0. 38	0. 40	0. 41	0. 43	0. 44	0. 46	0. 56	0. 70	0. 61
	3 Returns	2. 90	2. 93	3. 00	3. 04	3. 11	3. 16	3. 23	3. 28	3. 35	3. 41	3. 48	3. 53	3. 61	3. 66			
70	Sag	0. 39	0. 40	0. 42	0. 43	0. 45	0. 46	0. 48	0. 50	0. 52	0. 54	0. 56	0. 58	0. 60	0. 62	0. 76	0. 96	0. 84
	3 Returns	3. 38	3. 42	3. 50	3. 55	3. 63	3. 69	3. 77	3. 83	3. 92	3. 97	4. 06	4. 12	4. 21	4. 27			
80	Sag	0. 51	0. 52	0. 55	0. 56	0. 59	0. 61	0. 63	0. 65	0. 68	0. 70	0. 74	0. 76	0. 79	0. 81	0. 99	1. 25	1. 09
	3 Returns	3. 87	3. 91	4. 01	4. 06	4. 16	4. 21	4. 31	4. 38	4. 48	4. 54	4. 64	4. 71	4. 82	4. 89			
90	Sag	0. 64	0. 66	0. 69	0. 71	0. 74	0. 77	0. 80	0. 83	0. 86	0. 89	0. 93	0. 96	1. 00	1. 03	1. 25	1. 58	1. 38
	3 Returns	4. 35	4. 40	4. 51	4. 57	4. 68	4. 74	4. 85	4. 92	5. 04	5. 11	5. 23	5. 30	5. 42	5. 50			
100	Sag	0. 80	0. 82	0. 86	0. 88	0. 93	0. 95	1. 00	1. 03	1. 07	1. 11	1. 16	1. 19	1. 24	1. 28	1. 56	1. 96	1. 71
	3 Returns	4. 85	4. 90	5. 02	5. 09	5. 21	5. 29	5. 41	5. 49	5. 61	5. 70	5. 83	5. 91	6. 04	6. 13			
110	Sag	0. 97	0. 99	1. 04	1. 07	1. 12	1. 15	1. 21	1. 24	1. 30	1. 34	1. 40	1. 44	1. 50	1. 55	1. 88	2. 38	2. 06
	3 Returns	5. 33	5. 39	5. 53	5. 60	5. 73	5. 81	5. 95	6. 04	6. 18	6. 27	6. 41	6. 50	6. 64	6. 74			
120	Sag	1. 15	1. 18	1. 24	1. 27	1. 33	1. 37	1. 43	1. 48	1. 55	1. 59	1. 66	1. 71	1. 79	1. 84	2. 24	2. 83	2. 46
	3 Returns	5. 82	5. 88	6. 03	6. 11	6. 25	6. 34	6. 49	6. 59	6. 74	6. 84	6. 99	7. 09	7. 25	7. 35			
130	Sag	1. 35	1. 38	1. 45	1. 49	1. 56	1. 61	1. 68	1. 73	1. 81	1. 87	1. 95	2. 01	2. 10	2. 16	2. 63	3. 32	2. 88
	3 Returns	6. 30	6. 37	6. 53	6. 62	6. 77	6. 87	7. 03	7. 13	7. 30	7. 41	7. 57	7. 68	7. 85	7. 96			
140	Sag	1. 57	1. 61	1. 68	1. 73	1. 81	1. 86	1. 95	2. 01	2. 10	2. 17	2. 26	2. 33	2. 43	2. 51	3. 05	3. 85	3. 34
	3 Returns	6. 78	6. 86	7. 03	7. 12	7. 29	7. 40	7. 57	7. 68	7. 86	7. 98	8. 15	8. 27	8. 45	8. 58			
150	Sag	1. 80	1. 84	1. 93	1. 98	2. 08	2. 14	2. 24	2. 31	2. 41	2. 49	2. 60	2. 68	2. 80	2. 88	3. 50	4. 42	3. 84
	3 Returns	7. 27	7. 35	7. 53	7. 63	7. 81	7. 92	8. 11	8. 23	8. 42	8. 54	8. 73	8. 87	9. 06	9. 19			
CONDUCTOR		TENSION (kN)																
QUINCE 3/4/1. 75		1. 58	1. 52	1. 48	1. 42	1. 37	1. 31	1. 28	1. 22	1. 18	1. 13	1. 10	1. 05	1. 02	0. 97	0. 79	0. 62	
RAISIN 3/4/2. 50		3. 00	2. 93	2. 79	2. 72	2. 59	2. 52	2. 41	2. 34	2. 23	2. 17	2. 07	2. 01	1. 93	1. 88	1. 54	1. 22	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:2ºC

8.3 Sheet 45 **BARE ACSR (HIGH STEEL CONTENT)** **SEMI-URBAN (12% UTS)** **100m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0. 20	0. 20	0. 21	0. 22	0. 22	0. 23	0. 24	0. 24	0. 25	0. 26	0. 27	0. 27	0. 28	0. 29	0. 34	0. 41	0. 37
	3 Returns	2. 41	2. 44	2. 48	2. 52	2. 56	2. 60	2. 64	2. 68	2. 72	2. 76	2. 80	2. 84	2. 88	2. 92			
60	Sag	0. 28	0. 29	0. 30	0. 31	0. 32	0. 33	0. 34	0. 35	0. 36	0. 37	0. 38	0. 40	0. 41	0. 42	0. 49	0. 59	0. 53
	3 Returns	2. 89	2. 93	2. 98	3. 02	3. 07	3. 12	3. 17	3. 21	3. 26	3. 31	3. 36	3. 41	3. 45	3. 50			
80	Sag	0. 51	0. 52	0. 54	0. 55	0. 57	0. 59	0. 61	0. 63	0. 64	0. 66	0. 68	0. 70	0. 72	0. 74	0. 86	1. 04	0. 94
	3 Returns	3. 86	3. 91	3. 97	4. 03	4. 10	4. 16	4. 22	4. 29	4. 35	4. 42	4. 48	4. 55	4. 61	4. 67			
100	Sag	0. 79	0. 81	0. 84	0. 87	0. 89	0. 92	0. 95	0. 98	1. 01	1. 04	1. 07	1. 10	1. 13	1. 16	1. 35	1. 63	1. 47
	3 Returns	4. 82	4. 89	4. 97	5. 05	5. 12	5. 20	5. 28	5. 36	5. 44	5. 52	5. 60	5. 68	5. 76	5. 84			
120	Sag	1. 15	1. 18	1. 22	1. 26	1. 30	1. 34	1. 38	1. 42	1. 46	1. 51	1. 55	1. 59	1. 64	1. 68	1. 96	2. 37	2. 11
	3 Returns	5. 80	5. 89	5. 98	6. 07	6. 17	6. 26	6. 35	6. 45	6. 55	6. 65	6. 74	6. 84	6. 93	7. 03			
140	Sag	1. 56	1. 61	1. 66	1. 71	1. 76	1. 82	1. 87	1. 93	1. 99	2. 05	2. 11	2. 17	2. 23	2. 29	2. 66	3. 22	2. 87
	3 Returns	6. 77	6. 86	6. 98	7. 08	7. 19	7. 30	7. 41	7. 53	7. 64	7. 75	7. 86	7. 98	8. 09	8. 20			
160	Sag	2. 04	2. 10	2. 17	2. 23	2. 30	2. 37	2. 44	2. 52	2. 59	2. 68	2. 75	2. 83	2. 91	2. 99	3. 48	4. 21	3. 75
	3 Returns	7. 73	7. 84	7. 97	8. 09	8. 22	8. 35	8. 47	8. 60	8. 73	8. 86	8. 98	9. 12	9. 24	9. 37			
180	Sag	2. 58	2. 65	2. 74	2. 82	2. 91	3. 00	3. 09	3. 19	3. 28	3. 39	3. 48	3. 58	3. 68	3. 79	4. 40	5. 32	4. 75
	3 Returns	8. 70	8. 82	8. 97	9. 10	9. 25	9. 39	9. 53	9. 68	9. 82	9. 97	10. 11	10. 26	10. 39	10. 54			
200	Sag	3. 18	3. 27	3. 38	3. 49	3. 60	3. 71	3. 82	3. 94	4. 05	4. 18	4. 30	4. 43	4. 55	4. 68	5. 44	6. 57	5. 87
	3 Returns	9. 67	9. 80	9. 96	10. 11	10. 27	10. 43	10. 59	10. 75	10. 91	11. 07	11. 23	11. 39	11. 55	11. 71			
CONDUCTOR		TENSION (kN)																
QUINCE 3/4/1. 75		1. 60	1. 52	1. 50	1. 43	1. 41	1. 34	1. 33	1. 26	1. 25	1. 19	1. 18	1. 12	1. 11	1. 06	0. 90	0. 74	
RAISIN 3/4/2. 50		3. 01	2. 93	2. 83	2. 75	2. 67	2. 59	2. 51	2. 43	2. 36	2. 29	2. 23	2. 17	2. 11	2. 05	1. 76	1. 46	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:3ºC

8.3 Sheet 46 **BARE ACSR (HIGH STEEL CONTENT)** **SEMI-URBAN (12% UTS)** **150m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
80	Sag	0. 50	0. 52	0. 53	0. 54	0. 55	0. 57	0. 57	0. 59	0. 60	0. 61	0. 62	0. 64	0. 64	0. 66	0. 73	0. 84	0. 77
	3 Returns	3. 85	3. 91	3. 93	4. 00	4. 02	4. 08	4. 10	4. 16	4. 18	4. 25	4. 27	4. 33	4. 35	4. 41			
100	Sag	0. 79	0. 82	0. 82	0. 85	0. 86	0. 89	0. 90	0. 92	0. 93	0. 96	0. 97	1. 00	1. 01	1. 03	1. 14	1. 31	1. 20
	3 Returns	4. 81	4. 89	4. 92	5. 00	5. 02	5. 10	5. 13	5. 21	5. 23	5. 31	5. 33	5. 41	5. 44	5. 51			
120	Sag	1. 14	1. 17	1. 19	1. 23	1. 24	1. 28	1. 29	1. 33	1. 34	1. 38	1. 40	1. 44	1. 45	1. 49	1. 65	1. 89	1. 73
	3 Returns	5. 78	5. 87	5. 90	6. 00	6. 03	6. 13	6. 16	6. 25	6. 28	6. 37	6. 40	6. 50	6. 52	6. 61			
140	Sag	1. 55	1. 60	1. 62	1. 67	1. 69	1. 74	1. 76	1. 81	1. 83	1. 89	1. 90	1. 96	1. 97	2. 03	2. 24	2. 57	2. 35
	3 Returns	6. 74	6. 85	6. 89	7. 00	7. 04	7. 15	7. 18	7. 29	7. 33	7. 44	7. 47	7. 58	7. 61	7. 72			
160	Sag	2. 02	2. 09	2. 11	2. 18	2. 20	2. 27	2. 30	2. 37	2. 39	2. 46	2. 49	2. 56	2. 58	2. 65	2. 93	3. 36	3. 07
	3 Returns	7. 71	7. 83	7. 88	8. 00	8. 04	8. 17	8. 21	8. 34	8. 38	8. 50	8. 54	8. 66	8. 70	8. 82			
180	Sag	2. 57	2. 65	2. 68	2. 77	2. 80	2. 89	2. 92	3. 01	3. 04	3. 13	3. 16	3. 25	3. 28	3. 37	3. 72	4. 27	3. 89
	3 Returns	8. 69	8. 83	8. 88	9. 02	9. 07	9. 21	9. 25	9. 40	9. 44	9. 58	9. 63	9. 76	9. 81	9. 94			
200	Sag	3. 17	3. 28	3. 31	3. 42	3. 46	3. 57	3. 60	3. 71	3. 75	3. 86	3. 90	4. 01	4. 05	4. 16	4. 60	5. 27	4. 80
	3 Returns	9. 65	9. 81	9. 86	10. 02	10. 07	10. 23	10. 28	10. 44	10. 49	10. 65	10. 69	10. 85	10. 90	11. 04			
220	Sag	3. 84	3. 97	4. 01	4. 14	4. 18	4. 32	4. 36	4. 49	4. 54	4. 67	4. 72	4. 85	4. 90	5. 03	5. 56	6. 37	5. 81
	3 Returns	10. 61	10. 79	10. 85	11. 02	11. 08	11. 25	11. 31	11. 48	11. 54	11. 71	11. 76	11. 93	11. 98	12. 15			
240	Sag	4. 57	4. 72	4. 77	4. 93	4. 98	5. 14	5. 19	5. 35	5. 40	5. 56	5. 61	5. 77	5. 83	5. 99	6. 62	7. 59	6. 92
	3 Returns	11. 58	11. 77	11. 83	12. 02	12. 08	12. 28	12. 34	12. 53	12. 58	12. 77	12. 83	13. 01	13. 07	13. 25			
260	Sag	5. 36	5. 54	5. 60	5. 78	5. 84	6. 03	6. 09	6. 28	6. 34	6. 53	6. 59	6. 78	6. 84	7. 03	7. 77	8. 90	8. 12
	3 Returns	12. 54	12. 75	12. 82	13. 02	13. 09	13. 30	13. 36	13. 57	13. 63	13. 84	13. 90	14. 10	14. 16	14. 36			
280	Sag	6. 22	6. 42	6. 49	6. 71	6. 77	6. 99	7. 06	7. 28	7. 35	7. 57	7. 64	7. 86	7. 93	8. 15	9. 01	10. 33	9. 42
	3 Returns	13. 51	13. 73	13. 80	14. 02	14. 10	14. 32	14. 39	14. 61	14. 68	14. 90	14. 97	15. 18	15. 25	15. 46			
300	Sag	7. 14	7. 37	7. 46	7. 70	7. 78	8. 03	8. 10	8. 36	8. 44	8. 69	8. 77	9. 02	9. 10	9. 36	10. 34	11. 86	10. 81
	3 Returns	14. 47	14. 71	14. 79	15. 03	15. 10	15. 34	15. 42	15. 66	15. 73	15. 96	16. 04	16. 27	16. 34	16. 56			
CONDUCTOR		TENSION (kN)																
QUINCE 3/4/1. 75		1. 62	1. 52	1. 54	1. 46	1. 48	1. 39	1. 41	1. 34	1. 36	1. 28	1. 30	1. 23	1. 25	1. 19	1. 07	0. 92	
RAISIN 3/4/2. 50		3. 02	2. 92	2. 89	2. 80	2. 77	2. 69	2. 66	2. 58	2. 56	2. 48	2. 46	2. 39	2. 37	2. 31	2. 09	1. 82	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:4ºC

8.3 Sheet 47 **BARE ACSR (HIGH STEEL CONTENT)** **RURAL (22. 5% UTS)** **100m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
60	Sag	0. 14	0. 15	0. 15	0. 15	0. 15	0. 16	0. 16	0. 17	0. 17	0. 18	0. 18	0. 19	0. 18	0. 20	0. 23	0. 32	0. 37
	3 Returns	2. 03	2. 07	2. 07	2. 12	2. 12	2. 17	2. 17	2. 22	2. 22	2. 28	2. 27	2. 34	2. 33	2. 41			
70	Sag	0. 19	0. 20	0. 20	0. 21	0. 21	0. 22	0. 22	0. 23	0. 23	0. 24	0. 24	0. 25	0. 25	0. 27	0. 32	0. 43	0. 50
	3 Returns	2. 37	2. 42	2. 42	2. 47	2. 47	2. 53	2. 53	2. 59	2. 59	2. 66	2. 65	2. 73	2. 72	2. 81			
80	Sag	0. 25	0. 26	0. 26	0. 27	0. 27	0. 29	0. 28	0. 30	0. 30	0. 32	0. 31	0. 33	0. 33	0. 35	0. 42	0. 56	0. 65
	3 Returns	2. 71	2. 76	2. 77	2. 83	2. 83	2. 89	2. 89	2. 97	2. 96	3. 04	3. 03	3. 12	3. 10	3. 21			
90	Sag	0. 32	0. 33	0. 33	0. 34	0. 34	0. 36	0. 36	0. 38	0. 38	0. 40	0. 40	0. 42	0. 42	0. 44	0. 53	0. 71	0. 83
	3 Returns	3. 05	3. 11	3. 11	3. 18	3. 18	3. 26	3. 25	3. 34	3. 33	3. 42	3. 41	3. 51	3. 49	3. 61			
100	Sag	0. 39	0. 41	0. 41	0. 43	0. 43	0. 45	0. 44	0. 47	0. 47	0. 49	0. 49	0. 52	0. 51	0. 55	0. 65	0. 88	1. 02
	3 Returns	3. 39	3. 45	3. 46	3. 53	3. 53	3. 62	3. 61	3. 71	3. 70	3. 80	3. 79	3. 91	3. 88	4. 01			
110	Sag	0. 47	0. 49	0. 49	0. 51	0. 52	0. 54	0. 54	0. 57	0. 56	0. 60	0. 59	0. 63	0. 62	0. 66	0. 79	1. 07	1. 24
	3 Returns	3. 73	3. 80	3. 81	3. 89	3. 89	3. 98	3. 98	4. 08	4. 07	4. 18	4. 17	4. 30	4. 27	4. 42			
120	Sag	0. 56	0. 59	0. 59	0. 61	0. 61	0. 64	0. 64	0. 67	0. 67	0. 71	0. 70	0. 75	0. 74	0. 79	0. 94	1. 27	1. 47
	3 Returns	4. 07	4. 15	4. 15	4. 24	4. 24	4. 34	4. 34	4. 45	4. 44	4. 57	4. 55	4. 69	4. 66	4. 82			
130	Sag	0. 67	0. 69	0. 69	0. 72	0. 72	0. 76	0. 76	0. 80	0. 79	0. 84	0. 83	0. 88	0. 87	0. 93	1. 11	1. 50	1. 73
	3 Returns	4. 42	4. 50	4. 51	4. 61	4. 61	4. 72	4. 71	4. 83	4. 82	4. 96	4. 94	5. 09	5. 06	5. 23			
140	Sag	0. 77	0. 80	0. 80	0. 84	0. 84	0. 88	0. 88	0. 92	0. 92	0. 97	0. 96	1. 02	1. 01	1. 08	1. 29	1. 74	2. 00
	3 Returns	4. 76	4. 85	4. 86	4. 96	4. 96	5. 08	5. 07	5. 21	5. 19	5. 34	5. 32	5. 48	5. 45	5. 63			
150	Sag	0. 89	0. 92	0. 92	0. 96	0. 96	1. 01	1. 01	1. 06	1. 05	1. 11	1. 10	1. 17	1. 16	1. 24	1. 48	1. 99	2. 30
	3 Returns	5. 10	5. 20	5. 20	5. 31	5. 32	5. 44	5. 43	5. 58	5. 56	5. 72	5. 69	5. 87	5. 84	6. 04			
160	Sag	1. 01	1. 05	1. 05	1. 09	1. 10	1. 15	1. 14	1. 21	1. 20	1. 27	1. 26	1. 34	1. 32	1. 41	1. 68	2. 27	2. 61
	3 Returns	5. 44	5. 54	5. 55	5. 67	5. 67	5. 80	5. 80	5. 95	5. 93	6. 10	6. 07	6. 26	6. 23	6. 44			
170	Sag	1. 14	1. 18	1. 19	1. 24	1. 24	1. 30	1. 29	1. 36	1. 35	1. 43	1. 42	1. 51	1. 49	1. 59	1. 90	2. 56	2. 95
	3 Returns	5. 78	5. 89	5. 90	6. 02	6. 02	6. 17	6. 16	6. 32	6. 30	6. 48	6. 45	6. 66	6. 62	6. 84			
180		1. 28	1. 32	1. 33	1. 39	1. 39	1. 45	1. 45	1. 53	1. 52	1. 60	1. 59	1. 69	1. 67	1. 79	2. 13	2. 87	3. 31
		6. 12	6. 23	6. 24	6. 38	6. 38	6. 53	6. 52	6. 69	6. 67	6. 86	6. 83	7. 05	7. 01	7. 24			
190	Sag	1. 42	1. 47	1. 48	1. 54	1. 54	1. 62	1. 61	1. 70	1. 69	1. 79	1. 77	1. 88	1. 86	1. 99	2. 37	3. 20	3. 69
	3 Returns	6. 46	6. 58	6. 59	6. 73	6. 73	6. 89	6. 88	7. 06	7. 04	7. 24	7. 21	7. 44	7. 39	7. 64			
200	Sag	1. 58	1. 63	1. 64	1. 71	1. 71	1. 79	1. 79	1. 88	1. 87	1. 98	1. 96	2. 09	2. 06	2. 20	2. 62	3. 54	4. 08
	3 Returns	6. 80	6. 93	6. 94	7. 08	7. 09	7. 25	7. 24	7. 43	7. 41	7. 63	7. 59	7. 83	7. 78	8. 04			
CONDUCTOR		TENSION (kN)																
QUINCE 3/4/1. 75		2. 96	2. 86	2. 85	2. 73	2. 73	2. 60	2. 61	2. 48	2. 49	2. 36	2. 38	2. 24	2. 26	2. 12	1. 77	1. 31	
RAISIN 3/4/2. 50		5. 68	5. 49	5. 44	5. 23	5. 20	4. 98	4. 96	4. 73	4. 73	4. 48	4. 49	4. 24	4. 26	4. 01	3. 34	2. 48	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC:5ºC

8.3 Sheet 48 **BARE ACSR (HIGH STEEL CONTENT)** **RURAL (22. 5% UTS)** **150m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
80	Sag	0. 25	0. 26	0. 25	0. 27	0. 26	0. 28	0. 27	0. 30	0. 29	0. 31	0. 30	0. 32	0. 31	0. 34	0. 39	0. 49	0. 56
	3 Returns	2. 68	2. 76	2. 73	2. 82	2. 78	2. 88	2. 84	2. 95	2. 90	3. 01	2. 96	3. 08	3. 03	3. 16			
100	Sag	0. 38	0. 41	0. 40	0. 42	0. 41	0. 44	0. 43	0. 46	0. 45	0. 48	0. 47	0. 51	0. 49	0. 53	0. 61	0. 77	0. 87
	3 Returns	3. 35	3. 45	3. 42	3. 53	3. 48	3. 61	3. 55	3. 69	3. 63	3. 77	3. 70	3. 86	3. 78	3. 95			
120	Sag	0. 55	0. 59	0. 57	0. 61	0. 60	0. 64	0. 62	0. 67	0. 64	0. 70	0. 67	0. 73	0. 70	0. 76	0. 88	1. 11	1. 26
	3 Returns	4. 03	4. 15	4. 10	4. 24	4. 18	4. 33	4. 26	4. 42	4. 35	4. 52	4. 44	4. 63	4. 54	4. 74			
140	Sag	0. 75	0. 80	0. 78	0. 83	0. 81	0. 87	0. 84	0. 91	0. 88	0. 95	0. 92	0. 99	0. 96	1. 04	1. 20	1. 52	1. 71
	3 Returns	4. 70	4. 84	4. 79	4. 94	4. 88	5. 05	4. 97	5. 16	5. 08	5. 28	5. 19	5. 40	5. 30	5. 53			
160	Sag	0. 98	1. 04	1. 02	1. 09	1. 06	1. 13	1. 10	1. 19	1. 15	1. 24	1. 20	1. 30	1. 25	1. 36	1. 57	1. 98	2. 23
	3 Returns	5. 37	5. 53	5. 47	5. 65	5. 57	5. 77	5. 68	5. 90	5. 80	6. 03	5. 92	6. 17	6. 05	6. 32			
180	Sag	1. 24	1. 32	1. 29	1. 38	1. 34	1. 44	1. 39	1. 50	1. 45	1. 57	1. 51	1. 64	1. 58	1. 72	1. 99	2. 51	2. 83
	3 Returns	6. 04	6. 22	6. 15	6. 36	6. 27	6. 49	6. 40	6. 64	6. 53	6. 79	6. 67	6. 95	6. 81	7. 11			
200	Sag	1. 54	1. 63	1. 60	1. 70	1. 66	1. 78	1. 73	1. 86	1. 80	1. 95	1. 88	2. 04	1. 96	2. 13	2. 46	3. 11	3. 49
	3 Returns	6. 72	6. 93	6. 85	7. 07	6. 98	7. 23	7. 12	7. 39	7. 27	7. 56	7. 42	7. 73	7. 58	7. 91			
220	Sag	1. 86	1. 98	1. 93	2. 06	2. 01	2. 15	2. 09	2. 25	2. 18	2. 35	2. 27	2. 46	2. 37	2. 58	2. 97	3. 76	4. 23
	3 Returns	7. 39	7. 62	7. 53	7. 78	7. 68	7. 95	7. 83	8. 13	7. 99	8. 31	8. 16	8. 50	8. 34	8. 70			
240	Sag	2. 22	2. 35	2. 30	2. 45	2. 39	2. 56	2. 49	2. 68	2. 59	2. 80	2. 70	2. 93	2. 82	3. 07	3. 54	4. 48	5. 03
	3 Returns	8. 07	8. 31	8. 22	8. 49	8. 38	8. 67	8. 54	8. 86	8. 72	9. 07	8. 90	9. 28	9. 10	9. 49			
260	Sag	2. 60	2. 76	2. 70	2. 88	2. 80	3. 01	2. 92	3. 14	3. 04	3. 29	3. 17	3. 44	3. 31	3. 60	4. 16	5. 25	5. 90
	3 Returns	8. 74	9. 00	8. 90	9. 19	9. 07	9. 39	9. 25	9. 60	9. 45	9. 82	9. 65	10. 05	9. 86	10. 29			
280	Sag	3. 02	3. 20	3. 13	3. 34	3. 25	3. 49	3. 38	3. 64	3. 52	3. 81	3. 68	3. 99	3. 84	4. 18	4. 82	6. 09	6. 85
	3 Returns	9. 41	9. 69	9. 59	9. 90	9. 77	10. 12	9. 97	10. 34	10. 17	10. 58	10. 39	10. 82	10. 61	11. 08			
300	Sag	3. 46	3. 67	3. 59	3. 83	3. 73	4. 00	3. 88	4. 18	4. 05	4. 37	4. 22	4. 58	4. 41	4. 80	5. 53	7. 00	7. 86
	3 Returns	10. 08	10. 39	10. 27	10. 61	10. 47	10. 84	10. 68	11. 08	10. 90	11. 33	11. 13	11. 59	11. 37	11. 87			
CONDUCTOR		TENSION (kN)																
QUINCE 3/4/1. 75		3. 03	2. 86	2. 92	2. 74	2. 81	2. 62	2. 70	2. 51	2. 59	2. 40	2. 49	2. 29	2. 38	2. 19	1. 89	1. 50	
RAISIN 3/4/2. 50		5. 67	5. 49	5. 45	5. 25	5. 23	5. 03	5. 02	4. 80	4. 80	4. 59	4. 60	4. 38	4. 39	4. 17	3. 61	2. 87	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC:8ºC

8.3 Sheet 49 BARE ACSR (HIGH STEEL CONTENT) RURAL (22. 5% UTS) 200m RULING SPAN

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
80	Sag	0. 24	0. 26	0. 25	0. 27	0. 25	0. 28	0. 26	0. 29	0. 27	0. 30	0. 28	0. 32	0. 29	0. 33	0. 37	0. 44	0. 50
	3 Returns	2. 64	2. 76	2. 69	2. 82	2. 73	2. 87	2. 78	2. 93	2. 83	2. 99	2. 88	3. 04	2. 94	3. 11			
100	Sag	0. 37	0. 41	0. 38	0. 42	0. 40	0. 44	0. 41	0. 46	0. 43	0. 47	0. 44	0. 49	0. 46	0. 51	0. 58	0. 70	0. 77
	3 Returns	3. 30	3. 46	3. 36	3. 52	3. 42	3. 59	3. 48	3. 66	3. 54	3. 73	3. 61	3. 81	3. 68	3. 88			
120	Sag	0. 54	0. 59	0. 55	0. 61	0. 57	0. 63	0. 59	0. 66	0. 62	0. 68	0. 64	0. 71	0. 66	0. 74	0. 83	1. 00	1. 12
	3 Returns	3. 97	4. 15	4. 03	4. 23	4. 10	4. 31	4. 18	4. 39	4. 25	4. 48	4. 33	4. 57	4. 41	4. 66			
140	Sag	0. 73	0. 80	0. 75	0. 83	0. 78	0. 86	0. 81	0. 90	0. 84	0. 93	0. 87	0. 97	0. 90	1. 01	1. 13	1. 36	1. 52
	3 Returns	4. 63	4. 84	4. 71	4. 93	4. 79	5. 03	4. 87	5. 13	4. 96	5. 23	5. 05	5. 33	5. 15	5. 44			
160	Sag	0. 95	1. 04	0. 99	1. 08	1. 02	1. 13	1. 06	1. 17	1. 10	1. 22	1. 14	1. 27	1. 18	1. 32	1. 48	1. 78	1. 98
	3 Returns	5. 29	5. 53	5. 38	5. 64	5. 47	5. 75	5. 57	5. 86	5. 67	5. 98	5. 78	6. 10	5. 88	6. 22			
180	Sag	1. 21	1. 32	1. 25	1. 37	1. 29	1. 42	1. 34	1. 48	1. 39	1. 54	1. 44	1. 60	1. 49	1. 67	1. 87	2. 26	2. 51
	3 Returns	5. 95	6. 22	6. 05	6. 34	6. 16	6. 47	6. 27	6. 59	6. 38	6. 72	6. 50	6. 86	6. 62	6. 99			
200	Sag	1. 49	1. 63	1. 55	1. 70	1. 60	1. 76	1. 66	1. 83	1. 72	1. 91	1. 78	1. 98	1. 85	2. 06	2. 32	2. 80	3. 10
	3 Returns	6. 62	6. 93	6. 74	7. 06	6. 85	7. 20	6. 97	7. 34	7. 10	7. 48	7. 23	7. 63	7. 37	7. 78			
220	Sag	1. 81	1. 98	1. 87	2. 05	1. 94	2. 13	2. 00	2. 22	2. 08	2. 31	2. 16	2. 40	2. 24	2. 50	2. 41	3. 38	3. 75
	3 Returns	7. 29	7. 62	7. 41	7. 77	7. 54	7. 92	7. 67	8. 07	7. 81	8. 23	7. 95	8. 39	8. 10	8. 56			
240	Sag	2. 15	2. 35	2. 23	2. 44	2. 30	2. 54	2. 39	2. 64	2. 47	2. 75	2. 56	2. 86	2. 66	2. 97	3. 34	4. 03	4. 46
	3 Returns	7. 95	8. 31	8. 08	8. 47	8. 22	8. 64	8. 37	8. 80	8. 52	8. 98	8. 68	9. 16	8. 84	9. 34			
260	Sag	2. 53	2. 76	2. 61	2. 87	2. 70	2. 98	2. 80	3. 10	2. 90	3. 22	3. 01	3. 35	3. 12	3. 49	3. 92	4. 72	5. 24
	3 Returns	8. 61	9. 00	8. 76	9. 18	8. 91	9. 35	9. 07	9. 54	9. 23	9. 73	9. 40	9. 92	9. 58	10. 12			
280	Sag	2. 93	3. 20	3. 03	3. 33	3. 13	3. 46	3. 25	3. 59	3. 37	3. 74	3. 49	3. 89	3. 62	4. 04	4. 55	5. 48	6. 08
	3 Returns	9. 27	9. 70	9. 43	9. 88	9. 59	10. 07	9. 76	10. 27	9. 94	10. 47	10. 12	10. 68	10. 31	10. 90			
300	Sag	3. 36	3. 68	3. 48	3. 82	3. 60	3. 97	3. 73	4. 13	3. 86	4. 29	4. 01	4. 46	4. 16	4. 64	5. 22	6. 29	6. 98
	3 Returns	9. 93	10. 39	10. 10	10. 59	10. 28	10. 79	10. 46	11. 00	10. 65	11. 22	10. 84	11. 45	11. 05	11. 67			
CONDUCTOR		TENSION (kN)																
QUINCE 3/4/1. 75		3. 12	2. 86	3. 02	2. 75	2. 92	2. 65	2. 82	2. 54	2. 72	2. 45	2. 62	2. 35	2. 52	2. 26	2. 01	1. 66	
RAISIN 3/4/2. 50		5. 74	5. 49	5. 54	5. 28	5. 34	5. 08	5. 15	4. 88	4. 96	4. 69	4. 78	4. 51	4. 60	4. 34	3. 86	3. 23	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC:13ºC

8.3 Sheet 50 **BARE ACSR (HIGH STEEL CONTENT)** **RURAL (22. 5% UTS)** **250m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
80	Sag	0. 23	0. 26	0. 24	0. 27	0. 25	0. 28	0. 25	0. 29	0. 26	0. 30	0. 27	0. 31	0. 28	0. 32	0. 35	0. 41	0. 45
	3 Returns	2. 60	2. 76	2. 64	2. 81	2. 69	2. 86	2. 73	2. 91	2. 77	2. 96	2. 82	3. 01	2. 86	3. 06			
100	Sag	0. 36	0. 41	0. 37	0. 42	0. 38	0. 44	0. 40	0. 45	0. 41	0. 47	0. 42	0. 48	0. 44	0. 50	0. 55	0. 64	0. 71
	3 Returns	3. 26	3. 46	3. 31	3. 51	3. 36	3. 58	3. 41	3. 64	3. 47	3. 70	3. 52	3. 76	3. 58	3. 82			
120	Sag	0. 52	0. 59	0. 54	0. 61	0. 55	0. 63	0. 57	0. 65	0. 59	0. 67	0. 61	0. 69	0. 63	0. 72	0. 79	0. 92	1. 02
	3 Returns	3. 91	4. 15	3. 97	4. 22	4. 03	4. 29	4. 09	4. 36	4. 16	4. 44	4. 23	4. 51	4. 30	4. 59			
140	Sag	0. 71	0. 80	0. 73	0. 83	0. 75	0. 85	0. 78	0. 88	0. 80	0. 91	0. 83	0. 95	0. 86	0. 98	1. 08	1. 26	1. 38
	3 Returns	4. 56	4. 84	4. 63	4. 92	4. 70	5. 01	4. 78	5. 09	4. 85	5. 18	4. 93	5. 27	5. 01	5. 36			
160	Sag	0. 93	1. 04	0. 95	1. 08	0. 98	1. 12	1. 02	1. 15	1. 05	1. 19	1. 08	1. 24	1. 12	1. 28	1. 41	1. 64	1. 81
	3 Returns	5. 21	5. 53	5. 29	5. 63	5. 38	5. 72	5. 46	5. 82	5. 55	5. 92	5. 64	6. 02	5. 73	6. 12			
180	Sag	1. 17	1. 32	1. 21	1. 37	1. 25	1. 41	1. 29	1. 46	1. 33	1. 51	1. 37	1. 56	1. 42	1. 62	1. 78	2. 08	2. 28
	3 Returns	5. 87	6. 22	5. 96	6. 33	6. 05	6. 44	6. 14	6. 55	6. 24	6. 66	6. 34	6. 78	6. 45	6. 89			
200	Sag	1. 45	1. 63	1. 50	1. 69	1. 54	1. 75	1. 59	1. 81	1. 64	1. 87	1. 70	1. 94	1. 75	2. 00	2. 21	2. 57	2. 82
	3 Returns	6. 53	6. 93	6. 63	7. 05	6. 73	7. 17	6. 84	7. 29	6. 95	7. 41	7. 06	7. 54	7. 18	7. 67			
220	Sag	1. 76	1. 98	1. 81	2. 05	1. 87	2. 12	1. 93	2. 19	1. 99	2. 27	2. 05	2. 34	2. 12	2. 42	2. 67	3. 11	3. 41
	3 Returns	7. 18	7. 62	7. 29	7. 75	7. 40	7. 88	7. 52	8. 02	7. 64	8. 15	7. 77	8. 29	7. 89	8. 43			
240	Sag	2. 09	2. 35	2. 16	2. 43	2. 22	2. 52	2. 29	2. 61	2. 37	2. 70	2. 44	2. 79	2. 52	2. 88	3. 18	3. 71	4. 06
	3 Returns	7. 83	8. 31	7. 95	8. 45	8. 08	8. 60	8. 20	8. 75	8. 34	8. 90	8. 47	9. 05	8. 61	9. 20			
260	Sag	2. 45	2. 76	2. 53	2. 86	2. 61	2. 96	2. 69	3. 06	2. 78	3. 16	2. 87	3. 27	2. 96	3. 38	3. 73	4. 35	4. 77
	3 Returns	8. 49	9. 00	8. 62	9. 16	8. 75	9. 32	8. 89	9. 47	9. 03	9. 64	9. 18	9. 80	9. 33	9. 97			
280	Sag	2. 85	3. 20	2. 93	3. 31	3. 02	3. 43	3. 12	3. 55	3. 22	3. 67	3. 33	3. 79	3. 44	3. 92	4. 33	5. 04	5. 53
	3 Returns	9. 14	9. 70	9. 28	9. 86	9. 42	10. 03	9. 57	10. 20	9. 72	10. 38	9. 88	10. 55	10. 04	10. 73			
300	Sag	3. 27	3. 68	3. 37	3. 80	3. 47	3. 94	3. 58	4. 07	3. 70	4. 21	3. 82	4. 36	3. 94	4. 50	4. 97	5. 79	6. 35
	3 Returns	9. 79	10. 39	9. 94	10. 57	10. 10	10. 75	10. 25	10. 93	10. 42	11. 12	10. 59	11. 31	10. 76	11. 50			
CONDUCTOR		TENSION (kN)																
QUINCE 3/4/1. 75		3. 21	2. 86	3. 12	2. 76	3. 02	2. 67	2. 93	2. 58	2. 84	2. 49	2. 75	2. 41	2. 66	2. 33	2. 11	1. 81	
RAISIN 3/4/2. 50		5. 81	5. 48	5. 63	5. 30	5. 45	5. 13	5. 28	4. 96	5. 11	4. 79	4. 95	4. 64	4. 79	4. 49	4. 07	3. 52	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:19ºC

LVABC

8.3 Sheet 51 **LVABC** **SLACK (2% UTS)** **20m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	80ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
10	Sag	0. 16	0. 17	0. 17	0. 17	0. 17	0. 17	0. 17	0. 18	0. 18	0. 18	0. 18	0. 18	0. 18	0. 18	0. 19	0. 21	0. 15
	3 Returns	2. 19	2. 22	2. 21	2. 24	2. 23	2. 25	2. 25	2. 27	2. 27	2. 29	2. 29	2. 31	2. 30	2. 33			
15	Sag	0. 37	0. 38	0. 38	0. 39	0. 39	0. 39	0. 39	0. 40	0. 40	0. 41	0. 41	0. 41	0. 41	0. 42	0. 44	0. 47	0. 33
	3 Returns	3. 30	3. 34	3. 33	3. 37	3. 36	3. 40	3. 39	3. 43	3. 42	3. 45	3. 45	3. 48	3. 47	3. 51			
20	Sag	0. 67	0. 68	0. 68	0. 69	0. 69	0. 70	0. 70	0. 72	0. 71	0. 73	0. 72	0. 74	0. 72	0. 75	0. 78	0. 83	0. 59
	3 Returns	4. 42	4. 47	4. 46	4. 51	4. 50	4. 54	4. 53	4. 58	4. 57	4. 62	4. 61	4. 65	4. 64	4. 69			
25	Sag	1. 07	1. 09	1. 09	1. 11	1. 11	1. 13	1. 13	1. 15	1. 15	1. 17	1. 17	1. 19	1. 18	1. 21	1. 26	1. 34	0. 92
	3 Returns	5. 60	5. 66	5. 65	5. 71	5. 70	5. 76	5. 75	5. 81	5. 79	5. 85	5. 84	5. 90	5. 89	5. 94			
30	Sag	1. 54	1. 57	1. 57	1. 60	1. 59	1. 63	1. 62	1. 66	1. 65	1. 68	1. 68	1. 71	1. 70	1. 74	1. 81	1. 97	1. 33
	3 Returns	6. 71	6. 79	6. 77	6. 84	6. 83	6. 90	6. 89	6. 96	6. 95	7. 02	7. 00	7. 07	7. 06	7. 12			
35	Sag	2. 09	2. 14	2. 13	2. 18	2. 17	2. 22	2. 21	2. 26	2. 25	2. 29	2. 28	2. 33	2. 32	2. 36	2. 47	2. 63	1. 81
	3 Returns	7. 82	7. 91	7. 89	7. 98	7. 96	8. 05	8. 03	8. 11	8. 10	8. 18	8. 16	8. 24	8. 23	8. 30			
40	Sag	2. 73	2. 80	2. 79	2. 85	2. 84	2. 90	2. 89	2. 95	2. 93	3. 00	2. 98	3. 04	3. 03	3. 09	3. 22	3. 44	2. 37
	3 Returns	8. 93	9. 04	9. 01	9. 11	9. 09	9. 19	9. 17	9. 27	9. 25	9. 34	9. 32	9. 41	9. 40	9. 49			
CONDUCTOR		TENSION (kN)																
LVABC 2C 25mm2		0. 14	0. 14	0. 14	0. 14	0. 14	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 11	0. 11	
LVABC 2C 95mm2		0. 53	0. 53	0. 52	0. 52	0. 51	0. 50	0. 50	0. 49	0. 49	0. 48	0. 48	0. 47	0. 47	0. 47	0. 44	0. 40	
LVABC 4C 25mm2		0. 28	0. 28	0. 28	0. 27	0. 27	0. 27	0. 27	0. 26	0. 26	0. 26	0. 26	0. 26	0. 26	0. 25	0. 24	0. 22	
LVABC 4C 95mm2		1. 06	1. 06	1. 04	1. 03	1. 01	1. 01	0. 99	0. 99	0. 97	0. 97	0. 95	0. 95	0. 93	0. 93	0. 88	0. 81	
LVABC 4C 150mm2		1. 68	1. 67	1. 63	1. 63	1. 59	1. 58	1. 55	1. 55	1. 52	1. 51	1. 48	1. 48	1. 45	1. 45	1. 36	1. 25	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC:6ºC

8.3 Sheet 52 **LVABC** **SLACK (2% UTS)** **40m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	80ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
20	Sag	0. 70	0. 70	0. 70	0. 70	0. 70	0. 71	0. 71	0. 71	0. 71	0. 71	0. 71	0. 72	0. 72	0. 72	0. 73	0. 74	0. 53
	3 Returns	4. 52	4. 54	4. 53	4. 54	4. 54	4. 55	4. 55	4. 56	4. 56	4. 57	4. 57	4. 58	4. 58	4. 59			
30	Sag	1. 58	1. 59	1. 59	1. 60	1. 59	1. 60	1. 60	1. 61	1. 61	1. 62	1. 62	1. 62	1. 62	1. 63	1. 65	1. 68	1. 20
	3 Returns	6. 80	6. 82	6. 81	6. 83	6. 83	6. 85	6. 84	6. 86	6. 86	6. 88	6. 87	6. 89	6. 89	6. 90			
40	Sag	2. 83	2. 84	2. 84	2. 85	2. 85	2. 87	2. 86	2. 88	2. 88	2. 89	2. 89	2. 90	2. 90	2. 92	2. 95	3. 01	2. 14
	3 Returns	9. 08	9. 10	9. 10	9. 12	9. 12	9. 14	9. 14	9. 16	9. 16	9. 18	9. 17	9. 20	9. 19	9. 22			
50	Sag	4. 49	4. 52	4. 51	4. 54	4. 53	4. 56	4. 55	4. 58	4. 57	4. 60	4. 59	4. 62	4. 61	4. 64	4. 69	4. 79	3. 35
	3 Returns	11. 43	11. 46	11. 45	11. 48	11. 47	11. 51	11. 50	11. 53	11. 52	11. 55	11. 55	11. 58	11. 57	11. 60			
60	Sag	6. 49	6. 53	6. 52	6. 56	6. 55	6. 59	6. 58	6. 62	6. 61	6. 65	6. 64	6. 67	6. 67	6. 70	6. 79	6. 93	4. 84
	3 Returns	13. 70	13. 74	13. 73	13. 77	13. 76	13. 80	13. 79	13. 83	13. 82	13. 86	13. 85	13. 89	13. 88	13. 92			
70	Sag	8. 88	8. 93	8. 92	8. 97	8. 96	9. 01	9. 00	9. 05	9. 04	9. 09	9. 08	9. 13	9. 12	9. 17	9. 29	9. 48	6. 60
	3 Returns	15. 98	16. 03	16. 02	16. 06	16. 05	16. 09	16. 09	16. 13	16. 12	16. 16	16. 15	16. 20	16. 19	16. 23			
80	Sag	11. 67	11. 74	11. 73	11. 79	11. 78	11. 84	11. 83	11. 89	11. 88	11. 95	11. 93	12. 00	11. 99	12. 05	12. 20	12. 46	8. 65
	3 Returns	18. 27	18. 32	18. 30	18. 35	18. 34	18. 39	18. 38	18. 43	18. 42	18. 47	18. 46	18. 51	18. 50	18. 54			
CONDUCTOR		TENSION (kN)																
LVABC 2C 25mm2		0. 14	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 12	0. 12	
LVABC 2C 95mm2		0. 52	0. 52	0. 51	0. 51	0. 51	0. 51	0. 51	0. 51	0. 51	0. 50	0. 50	0. 50	0. 50	0. 50	0. 49	0. 47	
LVABC 4C 25mm2		0. 27	0. 27	0. 27	0. 27	0. 27	0. 27	0. 27	0. 27	0. 27	0. 26	0. 26	0. 26	0. 26	0. 26	0. 25	0. 25	
LVABC 4C 95mm2		1. 03	1. 03	1. 03	1. 03	1. 02	1. 02	1. 02	1. 02	1. 01	1. 01	1. 01	1. 00	1. 00	1. 00	0. 98	0. 95	
LVABC 4C 150mm2		1. 64	1. 64	1. 63	1. 63	1. 63	1. 62	1. 61	1. 61	1. 60	1. 60	1. 59	1. 59	1. 58	1. 58	1. 54	1. 50	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:6ºC

8.3 Sheet 53 **LVABC** **URBAN (6% UTS)** **40m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	80ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
20	Sag	0. 21	0. 23	0. 22	0. 23	0. 23	0. 24	0. 23	0. 25	0. 24	0. 26	0. 25	0. 27	0. 26	0. 27	0. 30	0. 33	0. 23
	3 Returns	2. 47	2. 57	2. 52	2. 62	2. 58	2. 67	2. 62	2. 71	2. 67	2. 75	2. 71	2. 79	2. 76	2. 83			
30	Sag	0. 47	0. 51	0. 49	0. 53	0. 51	0. 55	0. 53	0. 57	0. 55	0. 59	0. 57	0. 60	0. 59	0. 62	0. 67	0. 74	0. 51
	3 Returns	3. 71	3. 87	3. 79	3. 94	3. 87	4. 01	3. 95	4. 08	4. 02	4. 14	4. 08	4. 21	4. 15	4. 27			
40	Sag	0. 84	0. 91	0. 87	0. 94	0. 91	0. 98	0. 95	1. 01	0. 98	1. 04	1. 01	1. 08	1. 05	1. 11	1. 19	1. 33	0. 90
	3 Returns	4. 96	5. 16	5. 07	5. 26	5. 17	5. 36	5. 27	5. 45	5. 36	5. 53	5. 45	5. 62	5. 54	5. 70			
50	Sag	1. 33	1. 44	1. 39	1. 50	1. 44	1. 55	1. 50	1. 60	1. 55	1. 65	1. 61	1. 70	1. 66	1. 75	1. 89	2. 10	1. 41
	3 Returns	6. 24	6. 50	6. 38	6. 62	6. 51	6. 74	6. 63	6. 86	6. 75	6. 96	6. 86	7. 07	6. 97	7. 17			
60	Sag	1. 91	2. 07	2. 00	2. 15	2. 08	2. 23	2. 16	2. 31	2. 24	2. 38	2. 31	2. 45	2. 39	2. 52	2. 72	3. 03	2. 03
	3 Returns	7. 48	7. 79	7. 65	7. 94	7. 81	8. 09	7. 95	8. 22	8. 10	8. 35	8. 23	8. 48	8. 36	8. 60			
70	Sag	2. 60	2. 82	2. 71	2. 93	2. 83	3. 04	2. 94	3. 14	3. 04	3. 24	3. 15	3. 34	3. 25	3. 44	3. 71	4. 13	2. 77
	3 Returns	8. 72	9. 09	8. 92	9. 26	9. 10	9. 43	9. 28	9. 59	9. 44	9. 74	9. 60	9. 89	9. 75	10. 03			
80	Sag	3. 40	3. 68	3. 55	3. 83	3. 69	3. 96	3. 84	4. 10	3. 97	4. 23	4. 11	4. 35	4. 24	4. 48	4. 83	5. 37	3. 62
	3 Returns	9. 97	10. 39	10. 19	10. 58	10. 40	10. 77	10. 60	10. 95	10. 78	11. 12	10. 96	11. 28	11. 13	11. 44			
CONDUCTOR		TENSION (kN)																
LVABC 2C 25mm2		0. 46	0. 42	0. 44	0. 40	0. 42	0. 39	0. 40	0. 37	0. 39	0. 36	0. 37	0. 35	0. 36	0. 34	0. 31	0. 28	
LVABC 2C 95mm2		1. 66	1. 59	1. 58	1. 51	1. 50	1. 45	1. 44	1. 39	1. 38	1. 33	1. 33	1. 29	1. 28	1. 24	1. 13	1. 00	
LVABC 4C 25mm2		0. 91	0. 84	0. 87	0. 81	0. 83	0. 78	0. 80	0. 75	0. 78	0. 73	0. 75	0. 71	0. 73	0. 69	0. 63	0. 57	
LVABC 4C 95mm2		3. 27	3. 18	3. 11	3. 03	2. 97	2. 89	2. 84	2. 77	2. 73	2. 67	2. 63	2. 57	2. 54	2. 49	2. 27	2. 00	
LVABC 4C 150mm2		5. 15	5. 03	4. 86	4. 75	4. 61	4. 52	4. 40	4. 31	4. 21	4. 13	4. 04	3. 97	3. 89	3. 82	3. 46	3. 04	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:10ºC

8.3 Sheet 54 **LVABC** **URBAN (6% UTS)** **60m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	80ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
30	Sag	0.49	0.51	0.50	0.52	0.51	0.53	0.52	0.54	0.53	0.55	0.54	0.56	0.55	0.56	0.59	0.63	0.45
	3 Returns	3.81	3.88	3.84	3.91	3.88	3.94	3.91	3.98	3.95	4.01	3.98	4.04	4.01	4.07			
40	Sag	0.88	0.91	0.90	0.93	0.91	0.95	0.93	0.96	0.95	0.98	0.96	0.99	0.98	1.01	1.05	1.12	0.79
	3 Returns	5.08	5.18	5.13	5.22	5.18	5.27	5.22	5.31	5.27	5.35	5.31	5.39	5.35	5.43			
50	Sag	1.38	1.43	1.41	1.46	1.43	1.48	1.46	1.50	1.48	1.53	1.51	1.55	1.53	1.58	1.64	1.75	1.24
	3 Returns	6.36	6.48	6.42	6.53	6.48	6.59	6.53	6.64	6.59	6.70	6.64	6.75	6.70	6.80			
60	Sag	1.99	2.06	2.03	2.10	2.06	2.13	2.10	2.17	2.14	2.20	2.17	2.24	2.21	2.27	2.37	2.53	1.78
	3 Returns	7.64	7.77	7.71	7.84	7.78	7.91	7.85	7.97	7.91	8.04	7.98	8.10	8.04	8.16			
70	Sag	2.71	2.81	2.76	2.86	2.81	2.91	2.86	2.96	2.91	3.01	2.96	3.05	3.01	3.10	3.23	3.45	2.43
	3 Returns	8.91	9.07	8.99	9.15	9.08	9.23	9.16	9.31	9.23	9.38	9.31	9.45	9.38	9.52			
80	Sag	3.57	3.70	3.64	3.77	3.71	3.83	3.77	3.90	3.84	3.96	3.90	4.02	3.96	4.08	4.26	4.54	3.17
	3 Returns	10.23	10.41	10.32	10.50	10.42	10.59	10.51	10.68	10.60	10.77	10.68	10.85	10.77	10.93			
90	Sag	4.52	4.69	4.61	4.77	4.69	4.85	4.77	4.93	4.86	5.01	4.94	5.09	5.02	5.17	5.40	5.75	4.02
	3 Returns	11.50	11.71	11.61	11.81	11.71	11.91	11.82	12.01	11.92	12.11	12.02	12.20	12.11	12.29			
100	Sag	5.58	5.79	5.69	5.89	5.79	6.00	5.90	6.10	6.00	6.19	6.10	6.29	6.20	6.39	6.67	7.11	4.96
	3 Returns	12.78	13.01	12.90	13.13	13.01	13.24	13.13	13.35	13.24	13.45	13.35	13.56	13.45	13.66			
CONDUCTOR		TENSION (kN)																
LVABC 2C 25mm2		0.43	0.42	0.43	0.41	0.42	0.40	0.41	0.39	0.40	0.39	0.40	0.38	0.39	0.38	0.35	0.33	
LVABC 2C 95mm2		1.62	1.58	1.58	1.55	1.55	1.51	1.51	1.48	1.48	1.45	1.45	1.42	1.42	1.40	1.32	1.22	
LVABC 4C 25mm2		0.86	0.83	0.85	0.82	0.83	0.80	0.82	0.79	0.80	0.78	0.79	0.77	0.78	0.76	0.72	0.57	
LVABC 4C 95mm2		3.22	3.17	3.14	3.10	3.07	3.03	3.01	2.96	2.94	2.90	2.89	2.85	2.83	2.79	2.65	2.45	
LVABC 4C 150mm2		5.08	5.01	4.95	4.88	4.82	4.76	4.70	4.64	4.60	4.54	4.49	4.44	4.40	4.35	4.10	3.76	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:10ºC

8.3 Sheet 55 **LVABC** **URBAN (6% UTS)** **80m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	80ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
40	Sag	0.90	0.92	0.91	0.93	0.92	0.94	0.93	0.95	0.94	0.96	0.95	0.97	0.96	0.97	1.00	1.04	0.75
	3 Returns	5.14	5.20	5.17	5.22	5.20	5.25	5.22	5.27	5.25	5.30	5.27	5.32	5.30	5.34			
50	Sag	1.41	1.44	1.43	1.46	1.44	1.47	1.46	1.48	1.47	1.51	1.48	1.51	1.50	1.52	1.56	1.63	1.17
	3 Returns	6.44	6.50	6.47	6.53	6.50	6.56	6.53	6.60	6.56	6.63	6.60	6.66	6.63	6.69			
60	Sag	2.04	2.08	2.06	2.10	2.08	2.12	2.10	2.14	2.12	2.16	2.14	2.18	2.16	2.20	2.26	2.35	1.68
	3 Returns	7.73	7.80	7.77	7.84	7.81	7.88	7.84	7.92	7.88	7.95	7.92	7.99	7.96	8.03			
70	Sag	2.78	2.83	2.80	2.86	2.83	2.89	2.86	2.92	2.89	2.94	2.92	2.97	2.94	3.00	3.08	3.20	2.29
	3 Returns	9.02	9.11	9.06	9.15	9.11	9.20	9.15	9.24	9.20	9.28	9.24	9.33	9.28	9.37			
80	Sag	3.62	3.70	3.67	3.74	3.70	3.78	3.74	3.81	3.78	3.85	3.81	3.88	3.85	3.92	4.02	4.19	2.99
	3 Returns	10.31	10.41	10.36	10.46	10.41	10.51	10.46	10.56	10.52	10.61	10.56	10.66	10.61	10.71			
90	Sag	4.60	4.69	4.65	4.74	4.69	4.79	4.74	4.83	4.79	4.88	4.83	4.92	4.88	4.97	5.10	5.31	3.79
	3 Returns	11.60	11.72	11.66	11.77	11.72	11.83	11.78	11.89	11.83	11.94	11.89	12.00	11.94	12.05			
100	Sag	5.72	5.84	5.78	5.89	5.84	5.95	5.90	6.01	5.95	6.07	6.01	6.12	6.07	6.18	6.35	6.61	4.68
	3 Returns	12.93	13.06	12.99	13.12	13.06	13.19	13.13	13.25	13.19	13.31	13.25	13.37	13.31	13.44			
CONDUCTOR		TENSION (kN)																
LVABC 2C 25mm2		0.42	0.41	0.42	0.41	0.42	0.40	0.41	0.40	0.41	0.40	0.41	0.39	0.40	0.39	0.37	0.36	
LVABC 2C 95mm2		1.60	1.58	1.58	1.56	1.56	1.54	1.54	1.52	1.52	1.50	1.50	1.48	1.48	1.46	1.41	1.34	
LVABC 4C 25mm2		0.84	0.83	0.83	0.82	0.83	0.81	0.82	0.80	0.81	0.79	0.80	0.79	0.79	0.78	0.76	0.67	
LVABC 4C 95mm2		3.18	3.15	3.14	3.11	3.10	3.07	3.06	3.03	3.02	3.00	2.98	2.96	2.95	2.93	2.82	2.68	
LVABC 4C 150mm2		5.03	4.98	4.95	4.91	4.88	4.84	4.81	4.77	4.74	4.70	4.68	4.64	4.62	4.58	4.41	4.16	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:10ºC

8.3 Sheet 56 **LVABC** **URBAN (6% UTS)** **100m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	80ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	1. 44	1. 46	1. 45	1. 46	1. 46	1. 47	1. 46	1. 48	1. 47	1. 49	1. 48	1. 50	1. 49	1. 51	1. 54	1. 58	1. 13
	3 Returns	6. 49	6. 53	6. 51	6. 55	6. 53	6. 57	6. 55	6. 59	6. 57	6. 61	6. 59	6. 63	6. 61	6. 65			
60	Sag	2. 07	2. 10	2. 09	2. 11	2. 10	2. 13	2. 11	2. 14	2. 13	2. 15	2. 14	2. 16	2. 15	2. 18	2. 22	2. 28	1. 63
	3 Returns	7. 79	7. 84	7. 82	7. 87	7. 84	7. 89	7. 87	7. 92	7. 89	7. 94	7. 92	7. 96	7. 94	7. 99			
70	Sag	2. 82	2. 86	2. 84	2. 89	2. 86	2. 90	2. 88	2. 91	2. 90	2. 93	2. 91	2. 95	2. 93	2. 97	3. 02	3. 10	2. 22
	3 Returns	9. 10	9. 15	9. 13	9. 18	9. 15	9. 21	9. 18	9. 24	9. 21	9. 27	9. 24	9. 29	9. 27	9. 32			
80	Sag	3. 69	3. 74	3. 72	3. 76	3. 74	3. 79	3. 76	3. 81	3. 79	3. 83	3. 81	3. 86	3. 83	3. 88	3. 95	4. 06	2. 90
	3 Returns	10. 40	10. 46	10. 43	10. 50	10. 47	10. 53	10. 50	10. 56	10. 53	10. 59	10. 56	10. 63	10. 59	10. 66			
90	Sag	4. 68	4. 74	4. 71	4. 77	4. 74	4. 80	4. 77	4. 83	4. 80	4. 86	4. 83	4. 89	4. 86	4. 92	5. 00	5. 14	3. 68
	3 Returns	11. 70	11. 78	11. 74	11. 81	11. 78	11. 85	11. 81	11. 88	11. 85	11. 92	11. 89	11. 96	11. 92	11. 99			
100	Sag	5. 79	5. 86	5. 82	5. 90	5. 86	5. 93	5. 90	5. 97	5. 93	6. 01	5. 97	6. 04	6. 01	6. 08	6. 19	6. 36	4. 54
	3 Returns	13. 00	13. 09	13. 04	13. 13	13. 09	13. 17	13. 13	13. 21	13. 17	13. 25	13. 21	13. 29	13. 25	13. 33			
CONDUCTOR		TENSION (kN)																
LVABC 2C 25mm2		0. 42	0. 41	0. 41	0. 41	0. 41	0. 40	0. 41	0. 40	0. 41	0. 40	0. 40	0. 40	0. 40	0. 39	0. 38	0. 37	
LVABC 2C 95mm2		1. 58	1. 56	1. 57	1. 55	1. 54	1. 54	1. 53	1. 53	1. 51	1. 51	1. 50	1. 50	1. 50	1. 49	1. 45	1. 40	
LVABC 4C 25mm2		0. 83	0. 82	0. 82	0. 81	0. 82	0. 81	0. 81	0. 80	0. 81	0. 80	0. 80	0. 79	0. 80	0. 79	0. 77	0. 75	
LVABC 4C 95mm2		3. 15	3. 13	3. 12	3. 10	3. 09	3. 08	3. 07	3. 05	3. 04	3. 03	3. 02	3. 00	3. 00	2. 98	2. 91	2. 81	
LVABC 4C 150mm2		4. 98	4. 95	4. 93	4. 91	4. 89	4. 86	4. 84	4. 81	4. 80	4. 77	4. 75	4. 73	4. 71	4. 69	4. 56	4. 38	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:10ºC

8.3 Sheet 57 **LVABC** **SEMI-URBAN (10% UTS)** **50m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	80ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
30	Sag	0. 25	0. 31	0. 27	0. 32	0. 29	0. 34	0. 31	0. 36	0. 33	0. 38	0. 35	0. 39	0. 37	0. 41	0. 46	0. 52	0. 35
	3 Returns	2. 73	2. 99	2. 84	3. 09	2. 94	3. 17	3. 04	3. 26	3. 13	3. 33	3. 21	3. 40	3. 29	3. 47			
40	Sag	0. 45	0. 54	0. 49	0. 58	0. 53	0. 61	0. 56	0. 64	0. 59	0. 67	0. 63	0. 70	0. 66	0. 73	0. 81	0. 93	0. 62
	3 Returns	3. 64	4. 00	3. 79	4. 12	3. 93	4. 24	4. 05	4. 35	4. 17	4. 45	4. 29	4. 54	4. 39	4. 64			
50	Sag	0. 71	0. 85	0. 77	0. 91	0. 82	0. 96	0. 88	1. 01	0. 93	1. 06	0. 98	1. 10	1. 03	1. 15	1. 27	1. 46	0. 97
	3 Returns	4. 55	5. 00	4. 74	5. 15	4. 91	5. 30	5. 07	5. 44	5. 22	5. 56	5. 36	5. 69	5. 49	5. 80			
60	Sag	1. 03	1. 24	1. 11	1. 32	1. 20	1. 39	1. 28	1. 47	1. 35	1. 54	1. 43	1. 60	1. 50	1. 67	1. 85	2. 13	1. 40
	3 Returns	5. 49	6. 03	5. 72	6. 22	5. 93	6. 40	6. 12	6. 56	6. 30	6. 71	6. 47	6. 86	6. 63	7. 00			
70	Sag	1. 39	1. 67	1. 50	1. 78	1. 61	1. 88	1. 72	1. 98	1. 82	2. 07	1. 92	2. 16	2. 02	2. 25	2. 50	2. 88	1. 91
	3 Returns	6. 38	7. 00	6. 64	7. 22	6. 88	7. 43	7. 11	7. 62	7. 32	7. 80	7. 51	7. 97	7. 70	8. 13			
80	Sag	1. 83	2. 20	1. 98	2. 34	2. 13	2. 48	2. 27	2. 61	2. 30	2. 73	2. 53	2. 85	2. 66	2. 97	3. 30	3. 79	2. 49
	3 Returns	7. 32	8. 04	7. 62	8. 29	7. 90	8. 52	8. 15	8. 74	8. 39	8. 95	8. 62	9. 14	8. 83	9. 33			
90	Sag	2. 31	2. 79	2. 50	2. 96	2. 69	3. 13	2. 87	3. 30	3. 04	3. 46	3. 21	3. 61	3. 37	3. 76	4. 17	4. 80	3. 16
	3 Returns	8. 23	9. 04	8. 57	9. 32	8. 88	9. 59	9. 17	9. 83	9. 44	10. 06	9. 70	10. 28	9. 93	10. 49			
100	Sag	2. 85	3. 44	3. 09	3. 66	3. 32	3. 87	3. 54	4. 07	3. 75	4. 27	3. 96	4. 46	4. 16	4. 64	5. 15	5. 93	3. 90
	3 Returns	9. 15	10. 04	9. 52	10. 36	9. 87	10. 65	10. 19	10. 92	10. 49	11. 18	10. 77	11. 42	11. 04	11. 65			
CONDUCTOR		TENSION (kN)																
LVABC 2C 25mm2		0. 91	0. 70	0. 83	0. 65	0. 77	0. 62	0. 71	0. 59	0. 67	0. 56	0. 63	0. 53	0. 60	0. 51	0. 46	0. 39	
LVABC 2C 95mm2		3. 25	2. 66	2. 95	2. 46	2. 71	2. 29	2. 51	2. 15	2. 34	2. 04	2. 20	1. 93	2. 07	1. 85	1. 63	1. 40	
LVABC 4C 25mm2		1. 68	1. 40	1. 55	1. 31	1. 45	1. 24	1. 36	1. 18	1. 28	1. 13	1. 21	1. 08	1. 16	1. 04	0. 93	0. 81	
LVABC 4C 95mm2		5. 98	5. 31	5. 48	4. 91	5. 07	4. 59	4. 73	4. 31	4. 44	4. 08	4. 19	3. 87	3. 98	3. 70	3. 27	2. 80	
LVABC 4C 150mm2		9. 51	8. 39	8. 64	7. 69	7. 94	7. 13	7. 35	6. 66	6. 86	6. 27	6. 45	5. 93	6. 10	5. 65	4. 96	4. 22	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:13ºC

8.3 Sheet 58 **LVABC** **SEMI-URBAN (10% UTS)** **75m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	80ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0. 69	0. 74	0. 72	0. 77	0. 75	0. 79	0. 77	0. 82	0. 80	0. 85	0. 83	0. 87	0. 86	0. 90	0. 97	1. 09	0. 82
	3 Returns	4. 49	4. 65	4. 59	4. 74	4. 68	4. 83	4. 77	4. 91	4. 85	4. 99	4. 93	5. 07	5. 01	5. 14			
60	Sag	0. 99	1. 06	1. 03	1. 1	1. 08	1. 14	1. 12	1. 18	1. 16	1. 22	1. 20	1. 26	1. 23	1. 30	1. 40	1. 93	1. 17
	3 Returns	5. 39	5. 58	5. 51	5. 69	5. 62	5. 8	5. 72	5. 89	5. 83	5. 99	5. 92	6. 08	6. 01	6. 17			
70	Sag	1. 36	1. 46	1. 42	1. 52	1. 48	1. 57	1. 53	1. 63	1. 59	1. 68	1. 64	1. 73	1. 69	1. 83	1. 59	2. 19	1. 60
	3 Returns	6. 32	6. 54	6. 46	6. 67	6. 59	6. 79	6. 71	6. 91	6. 83	7. 02	6. 94	7. 13	7. 05	7. 33			
80	Sag	1. 54	1. 68	1. 59	1. 73	1. 64	1. 78	1. 69	1. 83	1. 74	1. 87	1. 79	1. 92	1. 84	1. 96	2. 09	2. 30	2. 09
	3 Returns	6. 72	7. 01	6. 83	7. 12	6. 94	7. 22	7. 05	7. 32	7. 15	7. 41	7. 25	7. 50	7. 35	7. 59			
90	Sag	2. 54	2. 78	2. 63	2. 86	2. 72	2. 94	2. 81	3. 02	2. 89	3. 10	2. 97	3. 18	3. 05	3. 25	3. 47	3. 81	2. 64
	3 Returns	8. 64	9. 02	8. 79	9. 16	8. 93	9. 29	9. 07	9. 41	9. 20	9. 54	9. 33	9. 65	9. 45	9. 77			
100	Sag	3. 14	3. 43	3. 25	3. 53	3. 36	3. 64	3. 47	3. 74	3. 57	3. 83	3. 67	3. 93	3. 77	4. 02	4. 29	4. 71	3. 27
	3 Returns	9. 60	10. 03	9. 76	10. 18	9. 92	10. 32	10. 08	10. 46	10. 23	10. 60	10. 37	10. 73	10. 51	10. 85			
110	Sag	3. 80	4. 15	3. 94	4. 28	4. 07	4. 40	4. 20	4. 52	4. 32	4. 64	4. 44	4. 76	4. 56	4. 87	5. 20	5. 70	3. 95
	3 Returns	10. 56	11. 03	10. 74	11. 20	10. 92	11. 36	11. 09	11. 51	11. 25	11. 66	11. 41	11. 80	11. 56	11. 94			
120	Sag	4. 55	4. 97	4. 71	5. 12	4. 87	5. 27	5. 02	5. 41	5. 17	5. 55	5. 32	5. 69	5. 46	5. 83	6. 22	6. 83	4. 71
	3 Returns	11. 55	12. 06	11. 75	12. 25	11. 94	12. 42	12. 13	12. 59	12. 31	12. 75	12. 48	12. 91	12. 64	13. 06			
130	Sag	5. 34	5. 83	5. 53	6. 01	5. 72	6. 19	5. 90	6. 36	6. 07	6. 52	6. 24	6. 68	6. 41	6. 84	7. 30	8. 02	5. 52
	3 Returns	12. 51	13. 07	12. 73	13. 27	12. 94	13. 46	13. 14	13. 64	13. 33	13. 81	13. 52	13. 98	13. 70	14. 15			
140	Sag	6. 20	6. 77	6. 42	6. 97	6. 63	7. 18	6. 84	7. 37	7. 04	7. 57	7. 24	7. 75	7. 44	7. 94	8. 47	9. 30	6. 41
	3 Returns	13. 47	14. 07	13. 71	14. 29	13. 93	14. 49	14. 15	14. 69	14. 36	14. 87	14. 56	15. 06	14. 75	15. 23			
150	Sag	7. 12	7. 77	7. 37	8. 01	7. 61	8. 24	7. 85	8. 46	8. 09	8. 68	8. 31	8. 90	8. 54	9. 11	9. 72	10. 67	7. 36
	3 Returns	14. 44	15. 08	14. 69	15. 30	14. 93	15. 52	15. 16	15. 73	15. 38	15. 93	15. 59	16. 12	15. 80	16. 31			
CONDUCTOR		TENSION (kN)																
LVABC 2C 25mm2		0. 85	0. 70	0. 81	0. 68	0. 78	0. 66	0. 75	0. 64	0. 72	0. 62	0. 70	0. 60	0. 68	0. 59	0. 55	0. 50	
LVABC 2C 95mm2		2. 96	2. 65	2. 83	2. 55	2. 71	2. 46	2. 60	2. 37	2. 51	2. 30	2. 42	2. 23	2. 34	2. 17	2. 00	1. 79	
LVABC 4C 25mm2		1. 52	1. 39	1. 47	1. 35	1. 42	1. 31	1. 38	1. 28	1. 34	1. 25	1. 30	1. 22	1. 27	1. 19	1. 11	1. 01	
LVABC 4C 95mm2		5. 68	5. 30	5. 44	5. 10	5. 23	4. 92	5. 04	4. 75	4. 86	4. 60	4. 71	4. 46	4. 56	4. 34	4. 01	3. 59	
LVABC 4C 150mm2		9. 03	8. 37	8. 61	8. 01	8. 23	7. 69	7. 90	7. 41	7. 60	7. 15	7. 32	6. 91	7. 08	6. 70	6. 15	5. 48	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:13ºC

8.3 Sheet 59 **LVABC** **SEMI-URBAN (10% UTS)** **100m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	80ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0. 82	0. 86	0. 83	0. 87	0. 85	0. 89	0. 86	0. 90	0. 89	0. 92	0. 91	0. 93	0. 92	0. 94	0. 98	1. 05	0. 75
	3 Returns	4. 89	5. 02	4. 94	5. 06	4. 98	5. 10	5. 03	5. 14	5. 07	5. 18	5. 11	5. 22	5. 16	5. 26			
60	Sag	1. 18	1. 24	1. 20	1. 26	1. 22	1. 28	1. 24	1. 30	1. 26	1. 32	1. 29	1. 34	1. 31	1. 36	1. 42	1. 51	1. 08
	3 Returns	5. 87	6. 02	5. 93	6. 07	5. 98	6. 13	6. 04	6. 18	6. 09	6. 22	6. 14	6. 27	6. 19	6. 32			
70	Sag	1. 60	1. 68	1. 63	1. 71	1. 66	1. 74	1. 69	1. 77	1. 72	1. 80	1. 75	1. 83	1. 78	1. 85	1. 93	2. 06	1. 47
	3 Returns	6. 86	7. 03	6. 92	7. 09	6. 98	7. 15	7. 05	7. 21	7. 11	7. 26	7. 17	7. 32	7. 22	7. 37			
80	Sag	2. 09	2. 20	2. 13	2. 24	2. 17	2. 28	2. 21	2. 31	2. 25	2. 35	2. 29	2. 39	2. 33	2. 42	2. 53	2. 69	1. 91
	3 Returns	7. 84	8. 03	7. 91	8. 10	7. 98	8. 17	8. 06	8. 24	8. 12	8. 30	8. 19	8. 37	8. 26	8. 43			
90	Sag	2. 65	2. 79	2. 70	2. 84	2. 75	2. 88	2. 80	2. 93	2. 85	2. 98	2. 90	3. 02	2. 95	3. 07	3. 20	3. 41	2. 42
	3 Returns	8. 82	9. 04	8. 90	9. 12	8. 98	9. 20	9. 06	9. 27	9. 14	9. 34	9. 22	9. 42	9. 29	9. 49			
100	Sag	3. 28	3. 44	3. 34	3. 50	3. 40	3. 56	3. 46	3. 62	3. 52	3. 68	3. 58	3. 74	3. 64	3. 79	3. 96	4. 22	2. 99
	3 Returns	9. 80	10. 05	9. 89	10. 13	9. 98	10. 22	10. 07	10. 30	10. 16	10. 38	10. 24	10. 46	10. 33	10. 54			
110	Sag	3. 97	4. 17	4. 04	4. 24	4. 12	4. 31	4. 19	4. 39	4. 26	4. 46	4. 34	4. 52	4. 41	4. 59	4. 79	5. 11	3. 62
	3 Returns	10. 78	11. 05	10. 89	11. 15	10. 99	11. 24	11. 08	11. 33	11. 18	11. 42	11. 27	11. 51	11. 36	11. 60			
120	Sag	4. 72	4. 97	4. 81	5. 05	4. 90	5. 14	4. 99	5. 22	5. 08	5. 31	5. 16	5. 39	5. 25	5. 47	5. 71	6. 08	4. 31
	3 Returns	11. 76	12. 06	11. 88	12. 16	11. 99	12. 27	12. 09	12. 37	12. 20	12. 46	12. 30	12. 56	12. 40	12. 65			
130	Sag	5. 57	5. 86	5. 68	5. 96	5. 79	6. 06	5. 89	6. 16	5. 99	6. 26	6. 09	6. 36	6. 19	6. 45	6. 73	7. 18	5. 06
	3 Returns	12. 78	13. 10	12. 90	13. 21	13. 02	13. 32	13. 13	13. 43	13. 24	13. 54	13. 35	13. 64	13. 46	13. 74			
140	Sag	6. 46	6. 80	6. 59	6. 91	6. 71	7. 03	6. 83	7. 15	6. 95	7. 26	7. 07	7. 38	7. 18	7. 49	7. 81	8. 33	5. 87
	3 Returns	13. 76	14. 10	13. 89	14. 23	14. 02	14. 34	14. 14	14. 46	14. 26	14. 58	14/38	14. 69	14. 50	14. 80			
150	Sag	7. 42	7. 80	7. 57	7. 94	7. 71	8. 08	7. 85	8. 21	7. 98	8. 34	8. 12	8. 47	8. 25	8. 60	8. 97	9. 56	6. 74
	3 Returns	14. 74	15. 11	14. 88	15. 24	15. 02	15. 37	15. 15	15. 49	15. 28	15. 62	15. 41	15. 74	15. 53	15. 85			
CONDUCTOR		TENSION (kN)																
LVABC 2C 25mm2		0. 72	0. 65	0. 71	0. 64	0. 69	0. 63	0. 68	0. 62	0. 67	0. 61	0. 66	0. 60	0. 65	0. 59	0. 56	0. 53	
LVABC 2C 95mm2		2. 82	2. 64	2. 75	2. 58	2. 68	2. 53	2. 62	2. 47	2. 56	2. 42	2. 51	2. 38	2. 46	2. 33	2. 21	2. 04	
LVABC 4C 25mm2		1. 46	1. 39	1. 43	1. 36	1. 40	1. 34	1. 38	1. 32	1. 36	1. 30	1. 33	1. 28	1. 31	1. 26	1. 20	1. 13	
LVABC 4C 95mm2		5. 51	5. 28	5. 38	5. 16	5. 25	5. 05	5. 14	4. 95	5. 03	4. 85	4. 93	4. 75	4. 83	4. 66	4. 42	4. 09	
LVABC 4C 150mm2		8. 76	8. 35	8. 52	8. 14	8. 29	7. 94	8. 09	7. 75	7. 89	7. 58	7. 71	7. 41	7. 54	7. 26	6. 85	6. 29	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:13ºC

CCT

8.3 Sheet 60 **CCT** **SLACK (2% UTS)** **20m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	80ºC	
		INITIAL	FINAL	INITIA L	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
5	Sag	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 04	0. 03	0. 04	0. 04	0. 04	0. 04	0. 04	0. 03
	3 Returns	0. 94	0. 95	0. 96	0. 96	0. 97	0. 97	0. 98	0. 99	1. 00	1. 00	1. 01	1. 01	1. 02	1. 02			
10	Sag	0. 12	0. 13	0. 13	0. 13	0. 13	0. 13	0. 14	0. 14	0. 14	0. 14	0. 14	0. 14	0. 15	0. 15	0. 16	0. 17	0. 12
	3 Returns	1. 91	1. 92	1. 94	1. 95	1. 97	1. 98	2. 00	2. 01	2. 02	2. 03	2. 05	2. 06	2. 07	2. 08			
15	Sag	0. 28	0. 29	0. 29	0. 29	0. 30	0. 30	0. 31	0. 31	0. 32	0. 32	0. 32	0. 33	0. 33	0. 34	0. 36	0. 39	0. 28
	3 Returns	2. 88	2. 90	2. 93	2. 94	2. 97	2. 98	3. 01	3. 02	3. 05	3. 06	3. 09	3. 10	3. 12	3. 14			
20	Sag	0. 51	0. 51	0. 52	0. 53	0. 54	0. 54	0. 55	0. 56	0. 57	0. 57	0. 58	0. 59	0. 59	0. 60	0. 64	0. 70	0. 49
	3 Returns	3. 85	3. 87	3. 91	3. 93	3. 97	3. 99	4. 02	4. 04	4. 08	4. 09	4. 13	4. 15	4. 18	4. 19			
25	Sag	0. 81	0. 82	0. 84	0. 85	0. 86	0. 87	0. 89	0. 90	0. 91	0. 92	0. 93	0. 94	0. 96	0. 96	1. 03	1. 13	0. 77
	3 Returns	4. 88	4. 91	4. 96	4. 98	5. 03	5. 05	5. 10	5. 12	5. 16	5. 19	5. 23	5. 25	5. 29	5. 31			
30	Sag	1. 17	1. 18	1. 20	1. 22	1. 24	1. 25	1. 28	1. 29	1. 31	1. 32	1. 34	1. 35	1. 37	1. 39	1. 48	1. 62	1. 11
	3 Returns	5. 85	5. 88	5. 94	5. 97	6. 03	6. 06	6. 11	6. 14	6. 19	6. 22	6. 27	6. 30	6. 34	6. 37			
35	Sag	1. 59	1. 61	1. 64	1. 66	1. 69	1. 71	1. 73	1. 75	1. 78	1. 80	1. 83	1. 84	1. 89	1. 89	2. 01	2. 21	1. 51
	3 Returns	6. 82	6. 86	6. 93	6. 96	7. 03	7. 06	7. 12	7. 16	7. 22	7. 25	7. 31	7. 34	7. 40	7. 43			
40	Sag	2. 07	2. 10	2. 14	2. 16	2. 20	2. 23	2. 27	2. 29	2. 33	2. 35	2. 39	2. 41	2. 44	2. 46	2. 63	2. 89	1. 97
	3 Returns	7. 79	7. 83	7. 91	7. 95	8. 03	8. 07	8. 14	8. 18	8. 25	8. 28	8. 35	8. 39	8. 45	8. 48			
CONDUCTOR		TENSION (kN)																
CCT80		0. 37	0. 35	0. 36	0. 34	0. 35	0. 33	0. 34	0. 32	0. 33	0. 32	0. 32	0. 31	0. 31	0. 30	0. 28	0. 26	
CCT120		0. 55	0. 54	0. 53	0. 52	0. 51	0. 51	0. 50	0. 49	0. 49	0. 48	0. 47	0. 47	0. 46	0. 46	0. 43	0. 39	
CCT180		0. 84	0. 83	0. 81	0. 80	0. 78	0. 77	0. 75	0. 75	0. 73	0. 72	0. 71	0. 70	0. 69	0. 68	0. 63	0. 57	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC:Nil

8.3 Sheet 61 **CCT** **SLACK (2% UTS)** **40m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	80ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
20	Sag	0. 53	0. 54	0. 54	0. 54	0. 54	0. 54	0. 55	0. 55	0. 55	0. 55	0. 55	0. 56	0. 56	0. 56	0. 57	0. 59	0. 41
	3 Returns	3. 96	3. 96	3. 97	3. 98	3. 99	4. 00	4. 00	4. 01	4. 02	4. 03	4. 03	4. 04	4. 05	4. 05			
25	Sag	0. 81	0. 82	0. 82	0. 82	0. 83	0. 83	0. 83	0. 83	0. 84	0. 84	0. 84	0. 85	0. 85	0. 85	0. 87	0. 90	0. 63
	3 Returns	4. 88	4. 89	4. 90	4. 91	4. 92	4. 93	4. 94	4. 94	4. 96	4. 96	4. 97	4. 98	4. 99	5. 00			
30	Sag	1. 17	1. 18	1. 18	1. 19	1. 19	1. 20	1. 20	1. 20	1. 21	1. 21	1. 22	1. 22	1. 23	1. 23	1. 26	1. 30	0. 91
	3 Returns	5. 86	5. 87	5. 89	5. 89	5. 91	5. 92	5. 93	5. 94	5. 95	5. 96	5. 97	5. 98	6. 00	6. 00			
35	Sag	1. 60	1. 61	1. 61	1. 62	1. 63	1. 63	1. 64	1. 64	1. 65	1. 66	1. 66	1. 67	1. 67	1. 68	1. 72	1. 77	1. 24
	3 Returns	6. 85	6. 86	6. 87	6. 88	6. 90	6. 91	6. 92	6. 93	6. 95	6. 96	6. 98	6. 99	7. 00	7. 01			
40	Sag	2. 01	2. 10	2. 11	2. 12	2. 13	2. 13	2. 14	2. 15	2. 16	2. 17	2. 18	2. 18	2. 19	2. 20	2. 24	2. 32	1. 63
	3 Returns	7. 83	7. 84	7. 86	7. 87	7. 89	7. 90	7. 92	7. 93	7. 95	7. 96	7. 98	7. 99	8. 00	8. 02			
45	Sag	2. 69	2. 70	2. 71	2. 72	2. 73	2. 74	2. 76	2. 76	2. 78	2. 78	2. 80	2. 81	2. 82	2. 83	2. 89	2. 98	2. 06
	3 Returns	8. 87	8. 88	8. 90	8. 92	8. 94	8. 95	8. 97	8. 99	9. 01	9. 02	9. 04	9. 05	9. 07	9. 08			
50	Sag	3. 28	3. 29	3. 31	3. 32	3. 34	3. 35	3. 36	3. 37	3. 39	3. 40	3. 41	3. 42	3. 44	3. 45	3. 52	3. 64	2. 54
	3 Returns	9. 79	9. 81	9. 83	9. 84	9. 87	9. 88	9. 90	9. 92	9. 94	9. 96	9. 98	9. 99	10. 01	10. 03			
55	Sag	4. 03	4. 04	4. 06	4. 07	4. 09	4. 10	4. 12	4. 13	4. 15	4. 16	4. 18	4. 19	4. 21	4. 22	4. 31	4. 46	3. 08
	3 Returns	10. 84	10. 85	10. 88	10. 89	10. 92	10. 93	10. 96	10. 98	11. 00	11. 02	11. 04	11. 05	11. 08	11. 09			
CONDUCTOR		TENSION (kN)																
CCT80		0. 35	0. 34	0. 34	0. 34	0. 34	0. 34	0. 34	0. 34	0. 34	0. 33	0. 34	0. 33	0. 33	0. 33	0. 32	0. 31	
CCT120		0. 53	0. 53	0. 53	0. 53	0. 52	0. 52	0. 52	0. 52	0. 52	0. 51	0. 51	0. 51	0. 51	0. 51	0. 49	0. 48	
CCT180		0. 82	0. 82	0. 81	0. 81	0. 81	0. 80	0. 80	0. 80	0. 79	0. 79	0. 78	0. 78	0. 78	0. 77	0. 75	0. 72	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:2ºC

8.3 Sheet 62 **CCT** **URBAN (6% UTS)** **40m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	80ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
20	Sag	0. 15	0. 18	0. 16	0. 19	0. 17	0. 20	0. 18	0. 21	0. 19	0. 22	0. 20	0. 23	0. 21	0. 24	0. 26	0. 30	0. 20
	3 Returns	2. 10	2. 27	2. 18	2. 34	2. 25	2. 40	2. 32	2. 46	2. 39	2. 52	2. 45	2. 58	2. 51	2. 63			
30	Sag	0. 33	0. 38	0. 36	0. 41	0. 38	0. 43	0. 40	0. 45	0. 43	0. 48	0. 45	0. 50	0. 47	0. 52	0. 57	0. 66	0. 46
	3 Returns	3. 11	3. 36	3. 23	3. 46	3. 34	3. 56	3. 44	3. 65	3. 54	3. 73	3. 63	3. 82	3. 71	3. 89			
40	Sag	0. 59	0. 68	0. 63	0. 73	0. 68	0. 77	0. 72	0. 81	0. 76	0. 85	0. 80	0. 88	0. 84	0. 92	1. 02	1. 17	0. 82
	3 Returns	4. 15	4. 48	4. 31	4. 62	4. 46	4. 75	4. 59	4. 87	4. 72	4. 99	4. 84	5. 09	4. 96	5. 20			
50	Sag	0. 92	1. 07	0. 99	1. 14	1. 06	1. 20	1. 13	1. 27	1. 19	1. 33	1. 25	1. 38	1. 31	1. 44	1. 60	1. 84	1. 28
	3 Returns	5. 20	5. 61	5. 39	5. 78	5. 58	5. 94	5. 75	6. 09	5. 91	6. 24	6. 06	6. 37	6. 20	6. 50			
60	Sag	1. 34	1. 56	1. 44	1. 66	1. 54	1. 75	1. 64	1. 84	1. 73	1. 93	1. 82	2. 02	1. 91	2. 10	2. 33	2. 68	1. 84
	3 Returns	6. 27	6. 77	6. 51	6. 98	6. 73	7. 17	6. 94	7. 35	7. 13	7. 53	7. 31	7. 69	7. 48	7. 84			
70	Sag	1. 82	2. 12	1. 96	2. 26	2. 10	2. 39	2. 23	2. 51	2. 36	2. 63	2. 48	2. 75	2. 60	2. 86	3. 17	3. 64	2. 51
	3 Returns	7. 31	7. 89	7. 59	8. 14	7. 85	8. 36	8. 09	8. 58	8. 31	8. 78	8. 53	8. 97	8. 73	9. 15			
80	Sag	2. 38	2. 77	2. 56	2. 95	2. 74	3. 12	2. 91	3. 28	3. 08	3. 44	3. 24	3. 59	3. 40	3. 73	4. 14	4. 76	3. 28
	3 Returns	8. 35	9. 01	8. 67	9. 29	8. 97	9. 56	9. 24	9. 80	9. 50	10. 03	9. 74	10. 25	9. 97	10. 45			
CONDUCTOR		TENSION (kN)																
CCT80		1. 24	1. 05	1. 16	1. 00	1. 09	0. 95	1. 03	0. 91	0. 98	0. 87	0. 93	0. 84	0. 89	0. 81	0. 73	0. 64	
CCT120		1. 89	1. 62	1. 75	1. 53	1. 64	1. 44	1. 54	1. 37	1. 46	1. 31	1. 39	1. 26	1. 33	1. 21	1. 08	0. 94	
CCT180		3. 03	2. 50	2. 76	2. 32	2. 54	2. 17	2. 36	2. 05	2. 21	1. 94	2. 08	1. 85	1. 97	1. 76	1. 56	1. 34	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:11ºC

8.3 Sheet 63 **CCT** **URBAN (6% UTS)** **60m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	80ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
30	Sag	0. 36	0. 39	0. 37	0. 40	0. 38	0. 41	0. 39	0. 42	0. 40	0. 43	0. 41	0. 44	0. 42	0. 45	0. 48	0. 53	0. 38
	3 Returns	3. 23	3. 36	3. 29	3. 41	3. 34	3. 46	3. 39	3. 51	3. 44	3. 55	3. 49	3. 59	3. 53	3. 64			
40	Sag	0. 64	0. 69	0. 66	0. 71	0. 68	0. 73	0. 70	0. 75	0. 72	0. 77	0. 74	0. 78	0. 76	0. 80	0. 86	0. 94	0. 67
	3 Returns	4. 32	4. 49	4. 39	4. 56	4. 46	4. 62	4. 53	4. 68	4. 59	4. 74	4. 65	4. 80	4. 71	4. 85			
50	Sag	0. 99	1. 07	1. 03	1. 11	1. 06	1. 14	1. 09	1. 17	1. 12	1. 20	1. 16	1. 23	1. 19	1. 26	1. 34	1. 47	1. 05
	3 Returns	5. 40	5. 62	5. 49	5. 70	5. 58	5. 78	5. 66	5. 86	5. 74	5. 93	5. 82	6. 00	5. 90	6. 07			
60	Sag	1. 43	1. 55	1. 48	1. 60	1. 53	1. 64	1. 58	1. 69	1. 62	1. 73	1. 67	1. 77	1. 71	1. 81	1. 93	2. 12	1. 51
	3 Returns	6. 49	6. 74	6. 59	6. 84	6. 70	6. 94	6. 80	7. 03	6. 90	7. 12	6. 99	7. 21	7. 08	7. 29			
70	Sag	1. 95	2. 11	2. 02	2. 17	2. 08	2. 24	2. 15	2. 30	2. 21	2. 36	2. 27	2. 41	2. 33	2. 47	2. 63	2. 89	2. 06
	3 Returns	7. 57	7. 87	7. 70	7. 99	7. 82	8. 10	7. 94	8. 21	8. 05	8. 31	8. 16	8. 41	8. 26	8. 51			
80	Sag	2. 57	2. 78	2. 66	2. 86	2. 75	2. 95	2. 83	3. 03	2. 91	3. 10	2. 99	3. 18	3. 07	3. 26	3. 47	3. 81	2. 69
	3 Returns	8. 69	9. 03	8. 83	9. 16	8. 97	9. 29	9. 11	9. 42	9. 24	9. 54	9. 36	9. 65	9. 48	9. 76			
90	Sag	3. 26	3. 52	3. 37	3. 63	3. 48	3. 73	3. 58	3. 83	3. 68	3. 93	3. 78	4. 03	3. 88	4. 12	4. 39	4. 82	3. 40
	3 Returns	9. 77	10. 16	9. 93	10. 31	10. 09	10. 45	10. 42	10. 59	10. 39	10. 73	10. 53	10. 86	10. 66	10. 98			
100	Sag	4. 02	4. 35	4. 16	4. 48	4. 29	4. 61	4. 42	4. 73	4. 55	4. 85	4. 67	4. 97	4. 80	5. 09	5. 43	5. 95	4. 20
	3 Returns	10. 85	11. 28	11. 03	11. 45	11. 21	11. 61	11. 38	11. 77	11. 54	11. 92	11. 70	12. 06	11. 85	12. 20			
CONDUCTOR		TENSION (kN)																
CCT80		1. 13	1. 05	1. 10	1. 02	1. 07	1. 00	1. 04	0. 98	1. 02	0. 95	0. 99	0. 93	0. 97	0. 91	0. 86	0. 79	
CCT120		1. 75	1. 62	1. 69	1. 57	1. 64	1. 53	1. 59	1. 49	1. 55	1. 45	1. 50	1. 42	1. 47	1. 38	1. 29	1. 18	
CCT180		2. 76	2. 49	2. 64	2. 40	2. 54	2. 32	2. 45	2. 25	2. 36	2. 18	2. 29	2. 12	2. 22	2. 06	1. 91	1. 72	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:12ºC

8.3 Sheet 64 **CCT** **URBAN (6% UTS)** **80m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	80ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
40	Sag	0. 66	0. 69	0. 67	0. 70	0. 68	0. 71	0. 70	0. 72	0. 71	0. 74	0. 72	0. 75	0. 73	0. 76	0. 79	0. 84	0. 60
	3 Returns	4. 40	4. 50	4. 44	4. 54	4. 48	4. 57	4. 52	4. 61	4. 55	4. 65	4. 59	4. 68	4. 63	4. 72			
50	Sag	1. 03	1. 08	1. 05	1. 10	1. 07	1. 12	1. 09	1. 13	1. 11	1. 15	1. 12	1. 17	1. 14	1. 19	1. 24	1. 32	0. 94
	3 Returns	5. 50	5. 63	5. 55	5. 68	5. 60	5. 72	5. 65	5. 77	5. 70	5. 81	5. 74	5. 86	5. 79	5. 90			
60	Sag	1. 49	1. 56	1. 52	1. 58	1. 54	1. 61	1. 57	1. 64	1. 60	1. 66	1. 62	1. 69	1. 65	1. 71	1. 78	1. 90	1. 36
	3 Returns	6. 61	6. 76	6. 67	6. 81	6. 73	6. 87	6. 78	6. 93	6. 84	6. 98	6. 90	7. 03	6. 95	7. 08			
70	Sag	2. 03	2. 12	2. 06	2. 16	2. 10	2. 19	2. 14	2. 23	2. 17	2. 26	2. 21	2. 30	2. 24	2. 33	2. 43	2. 59	1. 85
	3 Returns	7. 71	7. 88	7. 78	7. 95	7. 85	8. 02	7. 92	8. 08	7. 98	8. 15	8. 05	8. 21	8. 11	8. 27			
80	Sag	2. 65	2. 77	2. 70	2. 82	2. 75	2. 87	2. 79	2. 91	2. 84	2. 96	2. 89	3. 00	2. 93	3. 05	3. 18	3. 38	2. 42
	3 Returns	8. 81	9. 01	8. 89	9. 09	8. 97	9. 17	9. 05	9. 24	9. 13	9. 31	9. 20	9. 38	9. 27	9. 45			
90	Sag	3. 36	3. 51	3. 42	3. 57	3. 48	3. 63	3. 54	3. 69	3. 60	3. 74	3. 66	3. 80	3. 71	3. 86	4. 02	4. 27	3. 06
	3 Returns	9. 92	10. 14	10. 01	10. 23	10. 10	10. 31	10. 18	10. 39	10. 27	10. 47	10. 35	10. 55	10. 43	10. 63			
100	Sag	4. 14	4. 34	4. 22	4. 41	4. 30	4. 49	4. 37	4. 56	4. 45	4. 63	4. 52	4. 70	4. 59	4. 77	5. 01	5. 34	3. 78
	3 Returns	11. 02	11. 27	11. 12	11. 37	11. 22	11. 46	11. 32	11. 56	11. 41	11. 65	11. 51	11. 75	11. 60	11. 82			
110	Sag	5. 05	5. 28	5. 15	5. 37	5. 24	5. 46	5. 33	5. 55	5. 41	5. 63	5. 50	5. 72	5. 59	5. 80	6. 05	6. 43	4. 58
	3 Returns	12. 16	12. 44	12. 27	12. 54	12. 38	12. 64	12. 49	12. 74	12. 59	12. 84	12. 69	12. 93	12. 79	13. 03			
CONDUCTOR		TENSION (kN)																
CCT80		1. 09	1. 04	1. 07	1. 03	1. 06	1. 01	1. 04	1. 00	1. 03	0. 99	1. 01	0. 97	1. 00	0. 96	0. 92	0. 87	
CCT120		1. 68	1. 61	1. 65	1. 58	1. 62	1. 56	1. 60	1. 53	1. 57	1. 51	1. 55	1. 49	1. 52	1. 46	1. 40	1. 32	
CCT180		2. 64	2. 48	2. 58	2. 43	2. 52	2. 38	2. 46	2. 33	2. 41	2. 29	2. 36	2. 25	2. 32	2. 21	2. 10	1. 95	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:13ºC

8.3 Sheet 65 CCT URBAN (6% UTS) 100m RULING SPAN

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	80ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	1. 05	1. 09	1. 07	1. 10	1. 08	1. 11	1. 09	1. 12	1. 10	1. 13	1. 11	1. 14	1. 13	1. 16	1. 19	1. 24	0. 89
	3 Returns	5. 56	5. 64	5. 59	5. 67	5. 63	5. 70	5. 66	5. 73	5. 69	5. 76	5. 72	5. 79	5. 75	5. 82			
60	Sag	1. 52	1. 56	1. 54	1. 58	1. 56	1. 60	1. 57	1. 62	1. 59	1. 63	1. 61	1. 65	1. 62	1. 67	1. 72	1. 79	1. 28
	3 Returns	6. 68	6. 77	6. 72	6. 81	6. 75	6. 85	6. 79	6. 89	6. 83	6. 92	6. 86	6. 96	6. 90	6. 99			
70	Sag	2. 07	2. 13	2. 09	2. 16	2. 12	2. 18	2. 14	2. 20	2. 17	2. 23	2. 19	2. 25	2. 21	2. 27	2. 34	2. 44	1. 74
	3 Returns	7. 79	7. 91	7. 84	7. 95	7. 88	7. 99	7. 93	8. 04	7. 97	8. 08	8. 01	8. 12	8. 05	8. 16			
80	Sag	2. 71	2. 79	2. 74	2. 82	2. 77	2. 85	2. 80	2. 88	2. 83	2. 91	2. 86	2. 94	2. 89	2. 97	3. 06	3. 20	2. 28
	3 Returns	8. 91	9. 04	8. 96	9. 09	9. 01	9. 14	9. 06	9. 19	9. 11	9. 23	9. 16	9. 28	9. 21	9. 33			
90	Sag	3. 43	3. 53	3. 47	3. 57	3. 51	3. 61	3. 55	3. 65	3. 59	3. 69	3. 63	3. 72	3. 66	3. 76	3. 87	4. 05	2. 89
	3 Returns	10. 02	10. 17	10. 08	10. 23	10. 14	10. 28	10. 20	10. 34	10. 25	10. 39	10. 31	10. 44	10. 36	10. 50			
100	Sag	4. 24	4. 36	4. 29	4. 41	4. 34	4. 46	4. 38	4. 51	4. 43	4. 55	4. 48	4. 60	4. 53	4. 65	4. 78	5. 00	3. 56
	3 Returns	11. 14	11. 30	11. 20	11. 37	11. 27	11. 43	11. 33	11. 49	11. 39	11. 55	11. 45	11. 61	11. 51	11. 66			
110	Sag	5. 13	5. 28	5. 19	5. 34	5. 25	5. 40	5. 31	5. 46	5. 37	5. 52	5. 43	5. 57	5. 48	5. 63	5. 79	6. 06	4. 31
	3 Returns	12. 25	12. 43	12. 33	12. 50	12. 40	12. 57	12. 47	12. 64	12. 53	12. 70	12. 60	12. 77	12. 67	12. 83			
120	Sag	6. 11	6. 29	6. 18	6. 36	6. 25	6. 43	6. 32	6. 50	6. 39	6. 57	6. 46	6. 64	6. 53	6. 70	6. 90	7. 22	5. 14
	3 Returns	13. 37	13. 57	13. 45	13. 64	13. 52	13. 72	13. 60	13. 79	13. 67	13. 86	13. 75	13. 93	13. 82	14. 00			
CONDUCTOR		TENSION (kN)																
CCT80		1. 07	1. 04	1. 06	1. 03	1. 05	1. 02	1. 04	1. 01	1. 03	1. 00	1. 02	0. 99	1. 01	0. 98	0. 95	0. 92	
CCT120		1. 65	1. 60	1. 63	1. 58	1. 61	1. 57	1. 59	1. 55	1. 58	1. 53	1. 56	1. 52	1. 54	1. 50	1. 46	1. 39	
CCT180		2. 57	2. 47	2. 53	2. 44	2. 50	2. 41	2. 46	2. 37	2. 43	2. 34	2. 40	2. 31	2. 36	2. 29	2. 20	2. 09	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:13ºC

8.3 Sheet 66 **CCT** **SEMI-URBAN (10% UTS)** **50m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	80ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
30	Sag	0. 16	0. 23	0. 17	0. 25	0. 19	0. 27	0. 21	0. 29	0. 23	0. 31	0. 25	0. 33	0. 27	0. 35	0. 40	0. 47	0. 33
	3 Returns	2. 14	2. 60	2. 26	2. 72	2. 38	2. 83	2. 49	2. 93	2. 61	3. 02	2. 72	3. 11	2. 82	3. 20			
40	Sag	0. 28	0. 41	0. 31	0. 45	0. 34	0. 48	0. 38	0. 52	0. 41	0. 55	0. 45	0. 59	0. 48	0. 62	0. 71	0. 84	0. 59
	3 Returns	2. 86	3. 47	3. 01	3. 63	3. 17	3. 77	3. 33	3. 91	3. 48	4. 04	3. 63	4. 15	3. 76	4. 27			
50	Sag	0. 44	0. 64	0. 48	0. 70	0. 54	0. 76	0. 59	0. 81	0. 65	0. 87	0. 70	0. 92	0. 76	0. 97	1. 11	1. 32	0. 92
	3 Returns	3. 58	4. 34	3. 77	4. 54	3. 97	4. 72	4. 16	4. 89	4. 35	5. 05	4. 53	5. 20	4. 71	5. 34			
60	Sag	0. 64	0. 93	0. 71	1. 00	0. 78	1. 08	0. 85	1. 15	0. 92	1. 22	1. 00	1. 29	1. 07	1. 36	1. 54	1. 82	1. 33
	3 Returns	4. 34	5. 21	4. 56	5. 42	4. 78	5. 62	5. 00	5. 81	5. 21	5. 99	5. 41	6. 15	5. 60	6. 31			
70	Sag	0. 86	1. 27	0. 96	1. 39	1. 06	1. 50	1. 17	1. 61	1. 28	1. 72	1. 39	1. 82	1. 50	1. 92	2. 20	2. 62	1. 81
	3 Returns	5. 04	6. 11	5. 31	6. 38	5. 58	6. 64	5. 86	6. 88	6. 13	7. 10	6. 38	7. 31	6. 63	7. 51			
80	Sag	1. 13	1. 66	1. 25	1. 81	1. 39	1. 96	1. 53	2. 11	1. 67	2. 25	1. 81	2. 38	1. 95	2. 51	2. 88	3. 42	2. 36
	3 Returns	5. 76	6. 98	6. 06	7. 29	6. 38	7. 59	6. 69	7. 86	7. 00	8. 12	7. 29	8. 36	7. 57	8. 58			
90	Sag	1. 43	2. 10	1. 59	2. 29	1. 75	2. 48	1. 93	2. 67	2. 11	2. 84	2. 29	3. 01	2. 47	3. 18	3. 64	4. 32	2. 99
	3 Returns	6. 47	7. 85	6. 82	8. 20	7. 18	8. 53	7. 53	8. 84	7. 87	9. 13	8. 20	9. 40	8. 51	9. 65			
100	Sag	1. 76	2. 59	1. 96	2. 83	2. 17	3. 06	2. 38	3. 29	2. 61	3. 51	2. 83	3. 72	3. 05	3. 92	4. 50	5. 34	3. 70
	3 Returns	7. 19	8. 72	7. 58	9. 11	7. 97	9. 48	8. 36	9. 82	8. 74	10. 14	9. 11	10. 44	9. 46	10. 72			
CONDUCTOR		TENSION (kN)																
CCT80		2. 39	1. 76	2. 18	1. 64	2. 00	1. 53	1. 85	1. 44	1. 72	1. 37	1. 61	1. 30	1. 51	1. 24	1. 10	0. 94	
CCT120		3. 98	2. 71	3. 59	2. 48	3. 24	2. 29	2. 94	2. 13	2. 69	2. 00	2. 48	1. 89	2. 30	1. 79	1. 56	1. 31	
CCT180		6. 25	4. 16	5. 62	3. 79	5. 06	3. 49	4. 58	3. 24	4. 16	3. 02	3. 82	2. 84	3. 52	2. 69	2. 33	1. 95	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:19ºC

8.3 Sheet 67 **CCT** **SEMI-URBAN (10% UTS)** **75m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	80ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0.51	0.64	0.54	0.67	0.57	0.70	0.60	0.73	0.63	0.76	0.66	0.79	0.69	0.82	0.89	1.01	0.73
	3 Returns	3.86	4.34	3.98	4.45	4.09	4.55	4.20	4.64	4.31	4.73	4.41	4.81	4.51	4.90			
60	Sag	0.73	0.93	0.78	0.97	0.82	1.02	0.87	1.06	0.91	1.10	0.96	1.14	1.00	1.18	1.29	1.46	1.06
	3 Returns	4.63	5.22	4.77	5.34	4.91	5.46	5.05	5.57	5.17	5.68	5.29	5.78	5.41	5.88			
70	Sag	1.00	1.26	1.06	1.32	1.12	1.38	1.18	1.44	1.24	1.50	1.30	1.55	1.36	1.60	1.76	1.99	1.44
	3 Returns	5.40	6.09	5.57	6.23	5.73	6.37	5.89	6.50	6.04	6.63	6.18	6.75	6.31	6.86			
80	Sag	1.30	1.65	1.38	1.73	1.46	1.81	1.54	1.88	1.62	1.96	1.70	2.03	1.78	2.10	2.30	2.60	1.88
	3 Returns	6.18	6.96	6.37	7.12	6.55	7.28	6.73	7.43	6.90	7.58	7.06	7.71	7.22	7.84			
90	Sag	1.65	2.09	1.75	2.19	1.85	2.29	1.96	2.38	2.06	2.48	2.15	2.57	2.25	2.66	2.91	3.29	2.38
	3 Returns	6.95	7.83	7.17	8.02	7.38	8.19	7.58	8.36	7.77	8.52	7.95	8.68	8.12	8.83			
100	Sag	2.05	2.58	2.17	2.70	2.30	2.82	2.42	2.94	2.54	3.05	2.66	3.16	2.77	3.26	3.57	4.03	2.94
	3 Returns	7.75	8.70	7.98	8.90	8.21	9.10	8.42	9.28	8.63	9.45	8.83	9.62	9.02	9.78			
110	Sag	2.49	3.14	2.64	3.29	2.80	3.43	2.94	3.57	3.09	3.71	3.23	3.84	3.37	3.97	4.34	4.91	3.55
	3 Returns	8.55	9.60	8.81	9.82	9.06	10.03	9.29	10.24	9.52	10.43	9.74	10.61	9.95	10.79			
120	Sag	2.95	3.74	3.13	3.92	3.32	4.10	3.50	4.27	3.68	4.43	3.85	4.60	4.03	4.76	5.21	5.90	4.23
	3 Returns	9.30	10.47	9.59	10.72	9.86	10.96	10.13	11.18	10.38	11.40	10.63	11.61	10.86	11.80			
130	Sag	3.46	4.39	3.68	4.60	3.89	4.81	4.11	5.01	4.32	5.20	4.52	5.40	4.72	5.58	6.11	6.93	4.97
	3 Returns	10.07	11.34	10.38	11.61	10.68	11.87	10.97	12.11	11.25	12.35	11.51	12.57	11.77	12.79			
140	Sag	4.01	5.09	4.26	5.34	4.52	5.58	4.76	5.81	5.01	6.04	5.25	6.26	5.48	6.47	7.09	8.04	5.76
	3 Returns	10.85	12.21	11.18	12.51	11.51	12.78	11.82	13.05	12.11	13.30	12.40	13.54	12.67	13.77			
150	Sag	4.60	5.85	4.90	6.13	5.18	6.40	5.47	6.67	5.75	6.93	6.02	7.19	6.29	7.43	8.14	9.23	6.61
	3 Returns	11.62	13.09	11.98	13.40	12.33	13.69	12.66	13.98	12.98	14.25	13.28	14.50	13.58	14.75			
CONDUCTOR		TENSION (kN)																
CCT80		2.11	1.75	2.00	1.68	1.91	1.62	1.82	1.56	1.75	1.51	1.68	1.46	1.62	1.42	1.30	1.16	
CCT120		3.43	2.70	3.22	2.58	3.05	2.47	2.89	2.37	2.75	2.28	2.62	2.20	2.51	2.13	1.94	1.71	
CCT180		5.55	4.16	5.16	3.93	4.81	3.73	4.51	3.56	4.25	3.40	4.02	3.26	3.82	3.14	2.83	2.46	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:22ºC

8.3 Sheet 68 **CCT** **SEMI-URBAN (10% UTS)** **100m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	80ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0.56	0.64	0.58	0.66	0.60	0.68	0.62	0.70	0.63	0.72	0.65	0.73	0.67	0.75	0.80	0.88	0.64
	3 Returns	4.04	4.35	4.12	4.41	4.18	4.47	4.25	4.53	4.32	4.59	4.38	4.64	4.44	4.70			
60	Sag	0.80	0.93	0.83	0.96	0.86	0.98	0.89	1.01	0.91	1.03	0.94	1.06	0.97	1.08	1.15	1.26	0.92
	3 Returns	4.86	5.22	4.94	5.30	5.02	5.37	5.10	5.44	5.18	5.51	5.26	5.57	5.33	5.64			
70	Sag	1.09	1.27	1.13	1.30	1.17	1.34	1.21	1.37	1.25	1.41	1.28	1.44	1.32	1.48	1.57	1.72	1.26
	3 Returns	5.67	6.09	5.77	6.18	5.86	6.27	5.96	6.35	6.05	6.43	6.13	6.50	6.22	6.58			
80	Sag	1.43	1.65	1.48	1.70	1.53	1.75	1.58	1.80	1.63	1.84	1.68	1.88	1.72	1.93	2.05	2.25	1.64
	3 Returns	6.48	6.97	6.59	7.07	6.70	7.16	6.81	7.26	6.91	7.35	7.01	7.44	7.11	7.52			
90	Sag	1.81	2.10	1.88	2.16	1.94	2.22	2.00	2.27	2.06	2.33	2.12	2.39	2.18	2.44	2.60	2.85	2.08
	3 Returns	7.29	7.84	7.42	7.95	7.54	8.06	7.66	8.17	7.78	8.27	7.89	8.37	8.00	8.46			
100	Sag	2.24	2.59	2.32	2.66	2.39	2.74	2.47	2.81	2.55	2.88	2.62	2.95	2.69	3.02	3.21	3.52	2.57
	3 Returns	8.10	8.71	8.24	8.84	8.38	8.96	8.52	9.08	8.64	9.19	8.77	9.30	8.89	9.41			
110	Sag	2.71	3.13	2.80	3.22	2.90	3.31	2.99	3.40	3.08	3.49	3.17	3.57	3.26	3.65	3.89	4.26	3.11
	3 Returns	8.91	9.58	9.07	9.72	9.22	9.86	9.37	9.98	9.51	10.11	9.65	10.23	9.78	10.35			
120	Sag	3.22	3.73	3.34	3.84	3.45	3.94	3.56	4.05	3.67	4.15	3.78	4.25	3.88	4.35	4.63	5.08	3.70
	3 Returns	9.72	10.46	9.89	10.61	10.06	10.75	10.22	10.89	10.38	11.03	10.53	11.16	10.67	11.29			
130	Sag	3.80	4.40	3.94	4.53	4.07	4.65	4.20	4.78	4.33	4.90	4.46	5.01	4.58	5.13	5.47	5.99	4.34
	3 Returns	10.56	11.36	10.75	11.52	10.93	11.68	11.10	11.83	11.27	11.98	11.43	12.12	11.59	12.26			
140	Sag	4.41	5.10	4.57	5.25	4.72	5.40	4.87	5.54	5.02	5.68	5.17	5.82	5.31	5.95	6.34	6.95	5.04
	3 Returns	11.37	12.23	11.57	12.41	11.77	12.58	11.95	12.74	12.13	12.90	12.31	13.05	12.48	13.20			
150	Sag	5.06	5.86	5.24	6.03	5.42	6.20	5.60	6.36	5.77	6.52	5.94	6.68	6.10	6.83	7.28	7.98	5.79
	3 Returns	12.18	13.10	12.40	13.29	12.60	13.47	12.81	13.65	13.00	13.82	13.19	13.98	13.37	14.14			
CONDUCTOR		TENSION (kN)																
CCT80		1.96	1.75	1.90	1.71	1.85	1.67	1.80	1.63	1.75	1.59	1.71	1.56	1.67	1.53	1.44	1.32	
CCT120		3.12	2.70	3.01	2.62	2.91	2.55	2.82	2.48	2.74	2.42	2.66	2.37	2.59	2.31	2.17	1.98	
CCT180		4.99	4.15	4.78	4.01	4.58	3.88	4.40	3.76	4.24	3.65	4.10	3.55	3.96	3.45	3.20	2.89	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:23ºC

8.3 Sheet 69 **CCT** **SEMI-URBAN (10% UTS)** **150m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	80ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
80	Sag	1. 56	1. 67	1. 58	1. 69	1. 60	1. 71	1. 63	1. 73	1. 65	1. 75	1. 67	1. 78	1. 69	1. 80	1. 86	1. 96	1. 43
	3 Returns	6. 76	6. 99	6. 81	7. 04	6. 86	7. 08	6. 91	7. 13	6. 96	7. 17	7. 01	7. 22	7. 05	7. 26			
90	Sag	1. 97	2. 11	2. 00	2. 14	2. 03	2. 17	2. 06	2. 19	2. 09	2. 22	2. 12	2. 25	2. 15	2. 28	2. 35	2. 48	1. 81
	3 Returns	7. 61	7. 87	7. 67	7. 92	7. 72	7. 97	7. 78	8. 02	7. 83	8. 07	7. 88	8. 12	7. 93	8. 17			
100	Sag	2. 44	2. 61	2. 47	2. 64	2. 51	2. 68	2. 55	2. 71	2. 58	2. 74	2. 62	2. 78	2. 65	2. 81	2. 91	3. 06	2. 23
	3 Returns	8. 46	8. 74	8. 52	8. 80	8. 58	8. 86	8. 64	8. 91	8. 70	8. 97	8. 76	9. 02	8. 82	9. 08			
110	Sag	2. 95	3. 15	2. 99	3. 20	3. 04	3. 24	3. 08	3. 28	3. 12	3. 32	3. 17	3. 36	3. 21	3. 40	3. 52	3. 71	2. 70
	3 Returns	9. 30	9. 62	9. 37	9. 68	9. 44	9. 75	9. 51	9. 81	9. 57	9. 87	9. 64	9. 93	9. 70	9. 99			
120	Sag	3. 51	3. 76	3. 57	3. 81	3. 62	3. 86	3. 67	3. 91	3. 72	3. 95	3. 77	4. 00	3. 82	4. 05	4. 19	4. 42	3. 22
	3 Returns	10. 15	10. 49	10. 22	10. 56	10. 30	10. 63	10. 37	10. 70	10. 44	10. 77	10. 51	10. 83	10. 58	10. 90			
130	Sag	4. 12	4. 41	4. 19	4. 47	4. 25	4. 53	4. 31	4. 59	4. 37	4. 64	4. 43	4. 70	4. 49	4. 76	4. 92	5. 19	3. 77
	3 Returns	11. 00	11. 37	11. 08	11. 44	11. 16	11. 52	11. 24	11. 59	11. 32	11. 67	11. 39	11. 74	11. 47	11. 81			
140	Sag	4. 78	5. 12	4. 86	5. 18	4. 93	5. 25	5. 00	5. 32	5. 07	5. 39	5. 14	5. 45	5. 20	5. 52	5. 71	6. 02	4. 38
	3 Returns	11. 84	12. 24	11. 93	12. 33	12. 02	12. 41	12. 10	12. 49	12. 19	12. 56	12. 27	12. 64	12. 35	12. 72			
150	Sag	5. 50	5. 88	5. 58	5. 95	5. 66	6. 03	5. 74	6. 11	5. 82	6. 18	5. 90	6. 26	5. 98	6. 33	6. 55	6. 90	5. 03
	3 Returns	12. 70	13. 12	12. 79	13. 21	12. 88	13. 29	12. 97	13. 38	13. 06	13. 46	13. 15	13. 54	13. 23	13. 62			
160	Sag	6. 26	6. 69	6. 35	6. 78	6. 44	6. 87	6. 54	6. 95	6. 63	7. 04	6. 72	7. 13	6. 80	7. 21	7. 46	7. 86	5. 72
	3 Returns	13. 54	14. 00	13. 64	14. 09	1. 74	14. 18	13. 84	14. 27	13. 93	14. 36	14. 02	14. 45	14. 12	14. 53			
170	Sag	7. 09	7. 58	7. 19	7. 68	7. 3	7. 78	7. 41	7. 88	7. 51	7. 98	7. 61	8. 08	7. 71	8. 18	8. 46	8. 92	6. 46
	3 Returns	14. 41	14. 9	14. 52	15	14. 62	15. 1	14. 73	15. 19	14. 83	15. 29	14. 93	15. 38	15. 03	15. 47			
180	Sag	7. 92	8. 47	8. 04	8. 59	8. 16	8. 70	8. 28	8. 81	8. 39	8. 92	8. 51	9. 03	8. 62	9. 14	9. 46	9. 97	7. 24
	3 Returns	15. 23	15. 75	15. 34	15. 85	15. 46	15. 96	15. 56	16. 06	15. 67	16. 16	15. 78	16. 26	15. 88	16. 35			
CONDUCTOR		TENSION (kN)																
CCT80		1. 85	1. 74	1. 83	1. 72	1. 81	1. 70	1. 78	1. 68	1. 76	1. 66	1. 74	1. 64	1. 72	1. 63	1. 57	1. 50	
CCT120		2. 86	2. 68	2. 82	2. 64	2. 78	2. 61	2. 74	2. 57	2. 70	2. 54	2. 67	2. 51	2. 63	2. 48	2. 39	2. 27	
CCT180		4. 50	4. 13	4. 42	4. 06	4. 34	4. 00	4. 26	3. 93	4. 19	3. 87	4. 12	3. 82	4. 05	3. 76	3. 61	3. 39	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:23ºC

HDC

8.3 Sheet 70 **HDC (Copper)** **SLACK (2% UTS)** **20m RULING SPAN**

		SAG (m) /TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
5	Sag	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 04	0. 04	0. 04	0. 04	0. 04	0. 04	0. 04	0. 04	0. 03
	3 Returns	0. 98	0. 98	0. 99	0. 99	1	1	1. 01	1. 01	1. 01	1. 02	1. 02	1. 02	1. 03	1. 04			
10	Sag	0. 13	0. 13	0. 14	0. 14	0. 14	0. 14	0. 14	0. 14	0. 14	0. 15	0. 15	0. 15	0. 15	0. 15	0. 16	0. 17	0. 13
	3 Returns	1. 99	1. 99	2. 00	2. 01	2. 02	2. 03	2. 04	2. 05	2. 06	2. 06	2. 08	2. 08	2. 10	2. 10			
15	Sag	0. 31	0. 31	0. 31	0. 31	0. 32	0. 32	0. 32	0. 32	0. 33	0. 33	0. 33	0. 34	0. 34	0. 34	0. 36	0. 38	0. 29
	3 Returns	2. 99	3. 00	3. 02	3. 03	3. 05	3. 06	3. 08	3. 09	3. 11	3. 11	3. 13	3. 14	3. 16	3. 16			
20	Sag	0. 55	0. 55	0. 56	0. 56	0. 57	0. 57	0. 58	0. 58	0. 59	0. 59	0. 60	0. 60	0. 61	0. 61	0. 64	0. 69	0. 51
	3 Returns	4. 00	4. 01	4. 04	4. 05	4. 08	4. 09	4. 12	4. 12	4. 15	4. 16	4. 19	4. 20	4. 22	4. 23			
25	Sag	0. 88	0. 88	0. 89	0. 90	0. 91	0. 92	0. 93	0. 93	0. 95	0. 95	0. 96	0. 97	0. 98	0. 98	1. 04	1. 10	0. 80
	3 Returns	5. 07	5. 08	5. 12	5. 13	5. 17	5. 18	5. 22	5. 23	5. 26	5. 27	5. 31	5. 32	5. 35	5. 36			
30	Sag	1. 26	1. 27	1. 29	1. 29	1. 31	1. 32	1. 34	1. 34	1. 36	1. 36	1. 38	1. 39	1. 41	1. 41	1. 48	1. 59	1. 16
	3 Returns	6. 08	6. 09	6. 14	6. 15	6. 20	6. 21	6. 25	6. 27	6. 31	6. 32	6. 36	6. 37	6. 42	6. 43			
35	Sag	1. 72	1. 72	1. 75	1. 76	1. 78	1. 79	1. 82	1. 82	1. 85	1. 86	1. 88	1. 89	1. 91	1. 92	2. 01	2. 16	1. 58
	3 Returns	7. 09	7. 10	7. 16	7. 17	7. 22	7. 24	7. 29	7. 30	7. 36	7. 37	7. 42	7. 43	7. 48	7. 49			
40	Sag	2. 24	2. 25	2. 29	2. 29	2. 33	2. 34	2. 37	2. 38	2. 42	2. 43	2. 46	2. 47	2. 50	2. 51	2. 63	2. 82	2. 06
	3 Returns	8. 09	8. 11	8. 17	8. 19	8. 25	8. 27	8. 33	8. 34	8. 40	8. 42	8. 47	8. 49	8. 54	8. 56			
CONDUCTOR		TENSION (kN)																
Cu 7/1. 75		0. 14	0. 14	0. 14	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 12	0. 12	0. 12	0. 11	0. 10	
Cu 7/2. 00		0. 18	0. 18	0. 17	0. 17	0. 17	0. 17	0. 17	0. 17	0. 16	0. 16	0. 16	0. 16	0. 16	0. 16	0. 15	0. 15	
Cu 7/2. 75		0. 32	0. 32	0. 32	0. 32	0. 31	0. 31	0. 31	0. 3	0. 3	0. 3	0. 3	0. 3	0. 29	0. 29	0. 27	0. 25	
Cu 19/2. 00		0. 49	0. 48	0. 47	0. 47	0. 46	0. 46	0. 45	0. 45	0. 44	0. 44	0. 44	0. 43	0. 43	0. 43	0. 4	0. 38	
Cu 19/3. 00		1. 01	1. 01	0. 99	0. 99	0. 98	0. 97	0. 96	0. 96	0. 95	0. 94	0. 93	0. 93	0. 92	0. 92	0. 87	0. 82	
Cu 37/2. 75		1. 67	1. 67	1. 64	1. 64	1,61	1. 61	1. 58	1. 58	1. 56	1. 56	1. 53	1. 53	1. 51	1. 51	1. 44	1. 35	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC: Nil

8.3 Sheet 71 **HDC (Copper)** **SLACK (2% UTS)** **40m RULING SPAN**

		SAG (m) /TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT		Temperature															
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
20	Sag	0. 55	0. 55	0. 55	0. 55	0. 56	0. 55	0. 56	0. 56	0. 56	0. 56	0. 56	0. 56	0. 56	0. 56	0. 57	0. 58	0. 46
	3 Returns	4. 02	4. 02	4. 03	4. 03	4. 04	4. 03	4. 04	4. 04	4. 05	4. 05	4. 05	4. 06	4. 06	4. 06			
25	Sag	0. 89	0. 89	0. 89	0. 89	0. 89	0. 89	0. 90	0. 89	0. 90	0. 90	0. 90	0. 90	0. 90	0. 90	0. 91	0. 93	0. 73
	3 Returns	5. 10	5. 09	5. 11	5. 10	5. 11	5. 11	5. 12	5. 12	5. 13	5. 13	5. 14	5. 13	5. 15	5. 14			
30	Sag	1. 25	1. 25	1. 26	1. 26	1. 27	1. 27	1. 27	1. 27	1. 28	1. 28	1. 29	1. 28	1. 29	1. 29	1. 30	134	1. 04
	3 Returns	6. 06	6. 06	6. 08	6. 07	6. 09	6. 09	6. 11	6. 10	6. 12	6. 12	6. 14	6. 13	6. 15	6. 15			
35	Sag	1. 71	1. 7	1. 72	1. 71	1. 72	1. 72	1. 73	1. 73	1. 74	1. 74	1. 75	1. 75	1. 76	1. 76	1. 79	1. 83	1. 42
	3 Returns	7. 07	7. 06	7. 08	7. 08	7. 10	7. 10	7. 12	7. 12	7. 14	7. 13	7. 16	7. 15	7. 18	7. 17			
40	Sag	2. 23	2. 23	2. 24	2. 24	2. 25	2. 25	2. 26	2. 26	2. 28	2. 28	2. 29	2. 29	2. 30	2. 30	2. 33	2. 39	1. 86
	3 Returns	8. 07	8. 07	8. 09	8. 09	8. 11	8. 13	8. 13	8. 16	8. 16	8. 18	8. 18	8. 20	8. 20	8. 22			
CONDUCTOR		TENSION (kN)																
Cu 7/1. 75		0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	0. 13	
Cu 7/2. 00		0. 17	0. 17	0. 17	0. 17	0. 17	0. 17	0. 17	0. 17	0. 17	0. 17	0. 17	0. 17	0. 17	0. 17	0. 17	0. 17	
Cu 7/2. 75		0. 32	0. 32	0. 31	0. 31	0. 31	0. 31	0. 31	0. 31	0. 31	0. 31	0. 31	0. 31	0. 31	0. 31	0. 31	0. 31	
Cu 19/2. 00		0. 47	0. 47	0. 46	0. 46	0. 46	0. 46	0. 46	0. 46	0. 46	0. 46	0. 45	0. 45	0. 45	0. 45	0. 45	0. 45	
Cu 19/3. 00		0. 98	0. 99	0. 97	0. 98	0. 97	0. 98	0. 97	0. 98	0. 97	0. 98	0. 97	0. 98	0. 97	0. 98	0. 98	0. 98	
Cu 37/2. 75		1. 63	1. 63	1. 62	1. 62	1. 62	1. 62	1. 61	1. 61	1. 60	1. 60	1. 60	1. 60	1. 59	1. 59	1. 56	1. 56	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC: Nil

8.3 Sheet 72 HDC (Copper) URBAN (6% UTS) 40m RULING SPAN

SPAN LENGTH (m)	ELEMENT	SAG (m) /TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
30	Sag	0. 40	0. 41	0. 42	0. 43	0. 44	0. 44	0. 45	0. 46	0. 47	0. 48	0. 48	0. 49	0. 50	0. 51	0. 55	0. 62	0. 45
	3 Returns	3. 44	3. 47	3. 52	3. 55	3. 58	3. 61	3. 65	3. 68	3. 71	3. 74	3. 77	3. 80	3. 83	3. 86			
40	Sag	0. 72	0. 73	0. 75	0. 76	0. 78	0. 79	0. 81	0. 82	0. 84	0. 85	0. 86	0. 88	0. 89	0. 90	0. 98	1. 01	0. 79
	3 Returns	4. 60	4. 64	4. 69	4. 73	4. 78	4. 82	4. 87	4. 91	4. 95	4. 99	5. 03	5. 07	5. 11	5. 15			
50	Sag	1. 13	1. 15	1. 17	1. 20	1. 22	1. 24	1. 27	1. 29	1. 31	1. 33	1. 35	1. 37	1. 39	1. 42	1. 54	1. 72	1. 24
	3 Returns	5. 75	5. 80	5. 87	5. 92	5. 89	6. 04	6. 09	6. 14	6. 20	6. 25	6. 30	6. 35	6. 39	6. 44			
60	Sag	1. 64	1. 67	1. 71	1. 74	1. 78	1. 81	1. 84	1. 88	1. 91	1. 94	1. 97	2. 00	2. 03	2. 06	2. 24	2. 50	1. 79
	3 Returns	6. 94	7. 00	7. 08	7. 15	7. 22	7. 28	7. 35	7. 41	7. 48	7. 56	7. 60	7. 66	7. 72	7. 78			
70	Sag	2. 24	2. 27	2. 33	2. 37	2. 42	2. 46	2. 51	2. 55	2. 60	2. 64	2. 68	2. 72	2. 76	2. 89	3. 04	3. 41	2. 43
	3 Returns	8. 09	8. 17	8. 26	8. 33	8. 42	8. 49	8. 58	8. 69	8. 72	8. 79	8. 86	8. 93	9. 00	9. 07			
80	Sag	2. 92	2. 97	3. 04	3. 09	3. 16	3. 22	3. 28	3. 33	3. 39	3. 45	3. 50	3. 56	3. 61	3. 67	3. 98	4. 45	3. 18
	3 Returns	9. 25	9. 33	9. 44	9. 52	9. 63	9. 72	9. 81	9. 88	9. 97	10. 06	10. 13	10. 22	10. 29	10. 37			
CONDUCTOR		TENSION (kN)																
Cu 7/1. 75		0. 42	0. 41	0. 41	0. 40	0. 39	0. 38	0. 38	0. 37	0. 36	0. 35	0. 35	0. 34	0. 34	0. 33	0. 30	0. 27	
Cu 7/2. 00		0. 54	0. 53	0. 52	0. 51	0. 50	0. 49	0. 48	0. 47	0. 47	0. 46	0. 45	0. 44	0. 44	0. 43	0. 39	0. 35	
Cu 7/2. 75		0. 98	0. 97	0. 95	0. 93	0. 91	0. 90	0. 88	0. 87	0. 85	0. 84	0. 83	0. 82	0. 80	0. 79	0. 73	0. 65	
Cu 19/2. 00		1. 46	1. 43	1. 40	1. 37	1. 34	1. 32	1. 30	1. 28	1. 25	1. 23	1. 21	1. 19	1. 18	1. 16	1. 06	0. 95	
Cu 19/3. 00		3. 06	3. 04	3. 95	2. 93	2. 85	2. 82	2. 76	2. 74	2. 68	2. 65	2. 60	2. 58	2. 53	2. 51	2. 32	2. 09	
Cu 37/2. 75		5. 03	5. 02	4. 85	4. 84	4. 69	4. 67	4. 54	4. 52	4. 40	4. 39	4. 27	4. 26	4. 15	4. 14	3. 84	3. 45	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC: 2ºC

8.3 Sheet 73 **HDC (Copper)** **URBAN (6% UTS)** **60m RULING SPAN**

		SAG (m) /TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
30	Sag	0. 41	0. 41	0. 42	0. 42	0. 42	0. 43	0. 43	0. 44	0. 44	0. 44	0. 45	0. 45	0. 45	0. 46	0. 48	0. 51	0. 39
	3 Returns	3. 46	3. 48	3. 5	3. 51	3. 53	3. 55	3. 56	3. 58	3. 59	3. 61	3. 62	3. 64	3. 65	3. 67			
40	Sag	0. 73	0. 74	0. 74	0. 75	0. 76	0. 76	0. 77	0. 78	0. 78	0. 79	0. 80	0. 81	0. 81	0. 83	0. 86	0. 92	0. 70
	3 Returns	4. 62	4. 65	4. 67	4. 69	4. 71	4. 74	4. 76	4. 78	4. 80	4. 82	4. 84	4. 86	4. 88	4. 90			
50	Sag	1. 14	1. 15	1. 16	1. 17	1. 19	1. 20	1. 21	1. 22	1. 23	1. 24	1. 25	1. 26	1. 27	1. 28	1. 34	1. 44	1. 09
	3 Returns	5. 78	5. 81	5. 84	5. 87	5. 90	5. 92	5. 95	5. 98	6. 00	6. 03	6. 05	6. 08	6. 10	6. 13			
60	Sag	1. 66	1. 68	1. 69	1. 71	1. 73	1. 74	1. 76	1. 77	1. 79	1. 81	1. 82	1. 84	1. 85	1. 87	1. 95	2. 05	1. 56
	3 Returns	6. 98	7. 01	7. 05	7. 08	7. 12	7. 15	7. 18	7. 21	7. 24	7. 28	7. 30	7. 34	7. 36	7. 40			
70	Sag	2. 26	2. 28	2. 31	2. 33	2. 35	2. 37	2. 39	2. 41	2. 43	2. 46	2. 48	2. 5	2. 52	2. 54	2. 66	2. 85	2. 13
	3 Returns	8. 14	8. 18	8. 22	8. 26	8. 30	8. 34	8. 37	8. 41	8. 45	8. 49	8. 52	8. 56	8. 59	8. 64			
80	Sag	2. 95	2. 98	3. 01	3. 04	3. 07	3. 10	3. 12	3. 15	3. 18	3. 21	3. 23	3. 26	3. 29	3. 32	3. 47	3. 72	2. 78
	3 Returns	9. 30	9. 35	9. 39	9. 44	9. 48	9. 53	9. 57	9. 61	9. 65	9. 69	9. 73	9. 78	9. 81	9. 86			
90	Sag	3. 71	3. 75	3. 78	3. 82	3. 86	3. 89	3. 93	3. 96	4. 00	4. 03	4. 07	4. 10	4. 13	4. 17	4. 37	4. 68	3. 53
	3 Returns	10. 43	10. 48	10. 53	10. 58	10. 63	10. 68	10. 72	10. 77	10. 82	10. 87	10. 91	10. 96	11. 00	11. 05			
100	Sag	4. 61	4. 66	4. 71	4. 75	4. 80	4. 84	4. 88	4. 93	4. 97	5. 02	5. 06	5. 10	5. 14	5. 19	5. 45	5. 82	4. 35
	3 Returns	11. 62	11. 68	11. 74	11. 79	11. 85	11. 90	11. 95	12. 01	12. 06	12. 11	12. 16	12. 22	12. 26	12. 32			
CONDUCTOR		TENSION (kN)																
Cu 7/1. 75		0. 42	0. 41	0. 41	0. 40	0. 40	0. 39	0. 39	0. 39	0. 39	0. 38	0. 38	0. 37	0. 37	0. 37	0. 35	0. 32	
Cu 7/2. 00		0. 54	0. 53	0. 53	0. 52	0. 52	0. 51	0. 51	0. 50	0. 50	0. 49	0. 49	0. 48	0. 48	0. 48	0. 45	0. 42	
Cu 7/2. 75		0. 97	0. 97	0. 96	0. 95	0. 94	0. 93	0. 92	0. 92	0. 91	0. 9	0. 89	0. 89	0. 88	0. 87	0. 83	0. 78	
Cu 19/2. 00		1. 44	1. 43	1. 41	1. 40	1. 39	1. 37	1. 36	1. 35	1. 34	1. 32	1. 31	1. 3	1. 29	1. 28	1. 22	1. 14	
Cu 19/3. 00		3. 04	3. 03	2. 99	2. 97	2. 94	2. 93	2. 89	2. 88	2. 85	2. 83	2. 80	2. 79	2. 76	2. 75	2. 63	2. 47	
Cu 37/2. 75		5. 01	5. 00	4. 92	4. 91	4. 84	4. 83	4. 76	4. 75	4. 69	4. 68	4. 61	4. 61	4. 55	4. 54	4. 35	4. 08	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC: 2ºC

8.3 Sheet 74 **HDC (Copper)** **URBAN (6% UTS)** **80m RULING SPAN**

		SAG (m) /TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
40	Sag	0. 77	0. 74	0. 77	0. 75	0. 75	0. 76	0. 76	0. 76	0. 77	0. 77	0. 78	0. 78	0. 78	0. 79	0. 81	0. 85	0. 65
	3 Returns	4. 64	4. 66	4. 67	4. 68	4. 70	4. 71	4. 72	4. 73	4. 75	4. 76	4. 77	4. 78	4. 79	4. 81			
50	Sag	1. 15	1. 16	1. 16	1. 17	1. 18	1. 18	1. 19	1. 20	1. 20	1. 21	1. 21	1. 22	1. 23	1. 23	1. 27	1. 33	1. 02
	3 Returns	5. 81	5. 83	5. 84	5. 86	5. 87	5. 89	5. 91	5. 92	5. 94	5. 95	5. 97	5. 98	6. 00	6. 01			
60	Sag	1. 68	1. 69	1. 69	1. 70	1. 71	1. 72	1. 73	1. 74	1. 75	1. 76	1. 77	1. 78	1. 79	1. 80	1. 85	1. 93	1. 47
	3 Returns	7. 01	7. 03	7. 05	7. 07	7. 09	7. 11	7. 13	7. 15	7. 16	7. 18	7. 20	7. 22	7. 24	7. 26			
70	Sag	2. 28	2. 29	2. 31	2. 32	2. 33	2. 34	2. 36	2. 37	2. 38	2. 39	2. 41	2. 42	2. 43	2. 44	2. 52	2. 63	2. 01
	3 Returns	8. 18	8. 20	8. 22	8. 25	8. 27	8. 29	8. 31	8. 33	8. 35	8. 38	8. 40	8. 42	8. 44	8. 46			
80	Sag	2. 98	3. 00	3. 01	3. 03	3. 04	3. 06	3. 08	3. 09	3. 11	3. 12	3. 14	3. 15	3. 17	3. 18	3. 27	3. 42	2. 62
	3 Returns	9. 35	9. 37	9. 4	9. 42	9. 44	9. 47	9. 49	9. 52	9. 54	9. 57	9. 59	9. 61	9. 63	9. 66			
90	Sag	3. 74	3. 77	3. 79	3. 81	3. 83	3. 85	3. 87	3. 89	3. 91	3. 93	3. 95	3. 97	3. 99	4. 01	4. 13	4. 32	3. 32
	3 Returns	10. 47	10. 50	10. 53	10. 56	10. 59	10. 62	10. 64	10. 67	10. 70	10. 73	10. 76	10. 79	10. 81	10. 84			
100	Sag	4. 65	4. 68	4. 71	4. 73	4. 76	4. 79	4. 81	4. 84	4. 86	4. 89	4. 91	4. 94	4. 96	4. 99	5. 14	5. 37	4. 10
	3 Returns	11. 67	11. 71	11. 74	11. 77	11. 80	11. 84	11. 87	11. 90	11. 93	11. 96	11. 99	12. 02	12. 05	12. 08			
CONDUCTOR		TENSION (kN)																
Cu 7/1. 75		0. 41	0. 41	0. 41	0. 40	0. 40	0. 40	0. 40	0. 40	0. 39	0. 39	0. 39	0. 39	0. 39	0. 38	0. 37	0. 35	
Cu 7/2. 00		0. 53	0. 53	0. 53	0. 52	0. 52	0. 52	0. 51	0. 51	0. 51	0. 51	0. 50	0. 50	0. 50	0. 49	0. 48	0. 46	
Cu 7/2. 75		0. 97	0. 96	0. 96	0. 95	0. 95	0. 94	0. 94	0. 93	0. 93	0. 92	0. 92	0. 91	0. 91	0. 91	0. 88	0. 84	
Cu 19/2. 00		1. 43	1. 42	1. 41	1. 4	1. 4	1. 39	1. 38	1. 37	1. 37	1. 36	1. 35	1. 34	1. 34	1. 33	1. 29	1. 24	
Cu 19/3. 00		3. 02	3. 01	2. 99	2. 98	2. 96	2. 95	2. 93	2. 92	2. 9	2. 9	2. 88	2. 87	2. 85	2. 84	2. 77	2. 67	
Cu 37/2. 75		4. 98	4. 97	4. 93	4. 92	4. 88	4. 88	4. 83	4. 83	4. 79	4. 78	4. 74	4. 74	4. 7	4. 7	4. 58	4. 41	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC: 2ºC

8.3 Sheet 75 **HDC (Copper)** **URBAN (6% UTS)** **100m RULING SPAN**

		SAG (m) /TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	1. 16	1. 16	1. 17	1. 17	1. 18	1. 18	1. 19	1. 19	1. 19	1. 20	1. 20	1. 21	1. 21	1. 21	1. 24	1. 28	0. 99
	3 Returns	5. 83	5. 85	5. 86	5. 87	5. 88	5. 89	5. 90	5. 91	5. 92	5. 93	5. 94	5. 95	5. 96	5. 97			
60	Sag	1. 69	1. 70	1. 70	1. 71	1. 71	1. 72	1. 73	1. 73	1. 74	1. 74	1. 75	1. 76	1. 76	1. 77	1. 80	1. 86	1. 43
	3 Returns	7. 04	7. 05	7. 07	7. 08	7. 09	7. 10	7. 11	7. 13	7. 14	7. 15	7. 16	7. 18	7. 19	7. 20			
70	Sag	2. 30	2. 31	2. 31	2. 33	2. 32	2. 34	2. 35	2. 36	2. 36	2. 37	2. 38	2. 39	2. 40	2. 41	2. 45	2. 53	1. 94
	3 Returns	8. 21	8. 23	8. 24	8. 26	8. 27	8. 28	8. 29	8. 31	8. 32	8. 34	8. 36	8. 37	8. 39	8. 40			
80	Sag	3. 00	3. 01	3. 02	3. 04	3. 05	3. 06	3. 07	3. 08	3. 09	3. 10	3. 11	3. 12	3. 13	3. 14	3. 20	3. 30	2. 54
	3 Returns	9. 38	9. 40	9. 41	9. 43	9. 45	9. 47	9. 48	9. 50	9. 51	9. 53	9. 55	9. 56	9. 58	9. 59			
90	Sag	3. 78	3. 79	3. 80	3. 82	3. 83	3. 84	3. 86	3. 87	3. 88	3. 90	3. 91	3. 92	3. 94	3. 95	4. 03	4. 15	3. 21
	3 Returns	10. 52	10. 54	10. 55	10. 57	10. 59	10. 61	10. 63	10. 65	10. 66	10. 68	10. 70	10. 72	10. 74	10. 76			
100	Sag	4. 69	4. 71	4. 73	4. 75	4. 76	4. 78	4. 79	4. 81	4. 83	4. 85	4. 86	4. 88	4. 89	4. 91	5. 01	5. 17	3. 97
	3 Returns	11. 72	11. 74	11. 76	11. 79	11. 81	11. 83	11. 85	11. 87	11. 89	11. 91	11. 93	11. 95	11. 97	11. 99			
CONDUCTOR		TENSION (kN)																
Cu 7/1. 75		0. 41	0. 41	0. 41	0. 40	0. 40	0. 40	0. 40	0. 40	0. 40	0. 39	0. 39	0. 39	0. 39	0. 39	0. 38	0. 45	
Cu 7/2. 00		0. 53	0. 52	0. 52	0. 52	0. 52	0. 52	0. 52	0. 51	0. 51	0. 51	0. 51	0. 51	0. 51	0. 50	0. 49	0. 47	
Cu 7/2. 75		0. 96	0. 95	0. 95	0. 95	0. 94	0. 94	0. 94	0. 94	0. 93	0. 93	0. 93	0. 92	0. 92	0. 92	0. 9	0. 87	
Cu 19/2. 00		1. 41	1. 41	1. 4	1. 4	1. 39	1. 39	1. 39	1. 39	1. 38	1. 38	1. 37	1. 37	1. 36	1. 36	1. 32	1. 28	
Cu 19/3. 00		2. 99	2. 99	2. 98	2. 97	2. 96	2. 95	2. 94	2. 93	2. 92	2. 92	2. 9	2. 9	2. 89	2. 88	2. 83	2. 75	
Cu 37/2. 75		4. 94	4. 94	4. 91	4. 91	4. 88	4. 88	4. 85	4. 84	4. 82	4. 82	4. 78	4. 79	4. 79	4. 76	4. 67	4. 54	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC: 3ºC

8.3 Sheet 76 **HDC (Copper)** **SEMI-URBAN (12% UTS)** **50m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) /TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0. 32	0. 33	0. 34	0. 37	0. 37	0. 40	0. 40	0. 44	0. 44	0. 48	0. 47	0. 52	0. 51	0. 56	0. 69	0. 89	0. 79
	3 Returns	3. 04	3. 13	3. 17	3. 28	3. 30	3. 43	3. 44	3. 59	3. 58	3. 75	3. 73	3. 91	3. 88	4. 06			
60	Sag	0. 80	0. 83	0. 86	0. 89	0. 92	0. 95	0. 98	1. 02	1. 03	108	1. 09	1. 14	1. 15	1. 20	1. 36	1. 61	1. 13
	3 Returns	4. 84	4. 92	5. 01	5. 11	5. 18	5. 29	5. 35	5. 46	5. 51	5. 62	5. 66	5. 78	5. 87	5. 92			
70	Sag	1. 09	1. 12	1. 17	1. 21	1. 25	1. 30	1. 33	1. 38	1. 41	1. 47	1. 49	1. 55	1. 57	1. 63	1. 86	2. 20	1. 54
	3 Returns	5. 64	5. 74	5. 85	5. 96	6. 05	6. 17	624	6. 37	6. 43	6. 56	6. 61	6. 74	6. 78	6. 91			
80	Sag	1. 43	1. 48	1. 54	1. 60	1. 64	1. 71	1. 75	1. 82	1. 86	1. 93	1. 96	2. 04	2. 06	2. 15	2. 45	2. 90	2. 02
	3 Returns	6. 48	6. 59	6. 71	6. 84	6. 94	7. 08	7. 17	7. 31	7. 38	7. 53	7. 58	7. 74	7. 78	7. 93			
90	Sag	1. 81	1. 87	1. 94	2. 02	2. 08	2. 16	2. 21	2. 31	2. 35	2. 45	2. 48	2. 58	2. 61	2. 71	3. 09	3. 67	2. 55
	3 Returns	7. 29	7. 41	7. 55	7. 70	7. 81	7. 97	8. 06	8. 22	8. 30	8. 47	8. 53	8. 70	8. 75	8. 92			
100	Sag	2. 24	2. 27	2. 33	2. 37	2. 42	2. 46	2. 51	2. 55	2. 6	2. 64	2. 68	2. 72	2. 76	2. 89	3. 20	3. 89	3. 15
	3 Returns	8. 14	8. 18	8. 22	8. 26	8. 3	8. 42	8. 37	8. 48	8. 47	8. 55	8. 76	8. 83	8. 98	9. 23			
CONDUCTOR		TENSION (kN)																
Cu 7/1. 75		1. 46	1. 38	1. 35	1. 26	1. 24	1. 15	1. 14	1. 05	1. 05	0. 96	0. 97	0. 89	0. 90	0. 82	0. 66	0. 51	
Cu 7/2. 00		1. 12	1. 07	1. 04	0. 99	0. 97	0. 92	0. 91	0. 87	0. 86	0. 82	0. 81	0. 77	0. 77	0. 73	0. 64	054	
Cu 7/2. 75		2. 00	1. 94	1. 87	1. 81	1. 75	1. 69	1. 65	1. 59	1. 55	1. 51	1. 47	1. 43	1. 40	1. 36	1. 38	1. 01	
Cu 19/2. 00		2. 97	2. 87	2. 76	2. 66	2. 58	2. 48	2. 42	2. 33	2. 29	2. 20	2. 16	2. 08	2. 06	1. 98	1. 73	1. 46	
Cu 19/3. 00		6. 18	6. 09	5. 78	5. 68	5. 43	5. 32	5. 12	5. 01	4. 85	4. 74	4. 61	4. 50	4. 40	4. 29	3. 79	3. 22	
Cu 37/2. 75		10. 12	9. 58	9. 49	9. 25	8. 94	8. 77	8. 44	8. 26	8. 00	7. 91	7. 61	7. 52	7. 26	6. 98	6. 55	6. 12	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC: 5ºC

8.3 Sheet 77 **HDC (Copper)** **SEMI-URBAN (12% UTS)** **75m RULING SPAN**

			SAG (m) /TIME FOR 3 TRAVELLING WAVE RETURNS (s)															BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT		Temperature															
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0. 56	0. 57	0. 58	0. 60	0. 60	0. 62	0. 63	0. 64	0. 65	0. 67	0. 67	0. 69	0. 69	0. 71	0. 78	0. 87	0. 65
	3 Returns	4. 04	4. 10	4. 13	4. 19	4. 21	4. 27	4. 29	4. 35	4. 36	4. 43	4. 44	4. 50	4. 51	4. 57			
60	Sag	0. 80	0. 83	0. 84	0. 86	0. 87	0. 90	0. 90	0. 93	0. 94	0. 96	0. 97	0. 99	1. 00	1. 03	1. 12	1. 26	0. 94
	3 Returns	4. 85	4. 93	4. 96	5. 03	5. 05	5. 13	5. 15	5. 22	5. 24	5. 32	5. 33	5. 40	5. 41	5. 39			
70	Sag	1. 09	1. 13	1. 14	1. 17	1. 19	1. 22	1. 23	1. 27	1. 27	1. 31	1. 32	1. 36	1. 36	1. 40	1. 52	1. 72	1. 27
	3 Returns	5. 67	5. 75	5. 78	5. 87	5. 90	5. 98	6. 01	6. 10	6. 12	6. 20	6. 22	6. 31	6. 32	6. 41			
80	Sag	1. 44	1. 48	1. 50	1. 55	1. 56	1. 61	1. 62	1. 67	1. 68	1. 73	1. 74	1. 79	1. 79	1. 84	2. 01	2. 26	1. 66
	3 Returns	6. 50	6. 60	6. 64	6. 73	6. 77	6. 87	6. 90	7. 00	7. 02	7. 12	7. 14	7. 24	7. 25	7. 35			
90	Sag	1. 82	1. 88	1. 90	1. 96	1. 98	2. 03	2. 05	2. 11	2. 12	2. 19	2. 20	2. 26	2. 27	2. 33	2. 54	2. 86	2. 11
	3 Returns	7. 31	7. 42	7. 47	7. 57	7. 61	7. 72	7. 76	7. 87	7. 89	8. 01	8. 03	8. 14	8. 16	8. 27			
100	Sag	2. 25	2. 32	2. 34	2. 41	2. 44	2. 51	2. 53	2. 60	2. 62	2. 70	2. 71	2. 79	2. 80	2. 88	3. 13	3. 53	2. 60
	3 Returns	8. 12	8. 24	8. 29	8. 41	8. 46	8. 58	8. 62	8. 74	8. 77	8. 89	8. 92	9. 04	9. 06	9. 29			
CONDUCTOR		TENSION (kN)																
Cu 7/1. 75		0. 87	0. 82	0. 83	0. 79	0. 80	0. 76	0. 77	0. 73	0. 74	0. 71	0. 71	0. 68	0. 69	0. 66	0. 60	0. 53	
Cu 7/2. 0		1. 11	1. 06	1. 06	1. 02	1. 02	0. 98	0. 98	0. 95	0. 95	0. 91	0. 91	0. 88	0. 88	0. 85	0. 78	0. 69	
Cu 7/2. 75		1. 99	1. 94	1. 91	1. 86	1. 84	1. 80	1. 77	1. 73	1. 72	1. 68	1. 66	1. 62	1. 61	1. 58	1. 45	1. 29	
Cu 19/2. 0		2. 95	2. 86	2. 83	2. 74	2. 72	2. 64	2. 62	2. 54	2. 53	2. 46	2. 44	2. 38	2. 37	2. 30	2. 11	1. 87	
Cu 19/3. 0		6. 16	6. 08	5. 93	5. 85	5. 73	5. 64	5. 54	5. 45	5. 36	5. 28	5. 20	5. 12	5. 05	4. 97	4. 59	4. 10	
Cu 32/2. 75		10. 12	10. 04	9. 76	9. 67	9. 42	9. 34	9. 11	9. 03	8. 83	8. 74	8. 56	8. 48	8. 32	8. 24	7. 60	6. 79	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC: 5ºC

8.3 Sheet 78 **HDC (Copper)** **SEMI-URBAN (12% UTS)** **100m RULING SPAN**

		SAG (m) /TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
60	Sag	0. 81	0. 83	0. 83	0. 85	0. 85	0. 87	0. 87	0. 89	0. 89	0. 91	0. 91	0. 93	0. 93	0. 95	1. 01	1. 10	0. 84
	3 Returns	4. 88	4. 93	4. 94	4. 99	5. 00	5. 06	5. 06	5. 12	5. 12	5. 17	5. 18	5. 23	5. 23	5. 29			
70	Sag	1. 10	1. 13	1. 13	1. 16	1. 16	1. 19	1. 19	1. 21	1. 22	1. 24	1. 24	1. 27	1. 27	1. 30	1. 31	1. 50	1. 14
	3 Returns	5. 69	5. 75	5. 77	5. 83	5. 84	5. 90	5. 91	5. 97	5. 98	6. 04	6. 04	6. 10	6. 11	6. 17			
80	Sag	1. 45	1. 49	1. 49	1. 52	1. 53	1. 56	1. 57	1. 60	1. 60	1. 64	1. 64	1. 67	1. 67	1. 71	1. 81	1. 97	1. 50
	3 Returns	6. 53	6. 60	6. 62	6. 69	6. 70	6. 77	6. 78	6. 93	6. 86	7. 01	6. 94	7. 08	7. 01	7. 15			
90	Sag	1. 84	1. 88	1. 89	1. 93	1. 94	1. 98	1. 98	2. 02	2. 03	2. 07	2. 07	2. 12	2. 12	2. 16	2. 29	2. 50	1. 89
	3 Returns	7. 35	7. 43	7. 44	7. 52	7. 54	7. 62	7. 63	7. 71	7. 71	7. 79	7. 80	7. 88	7. 88	7. 96			
100	Sag	2. 26	2. 31	2. 32	2. 37	2. 38	2. 43	2. 44	2. 49	2. 50	2. 55	2. 56	2. 61	2. 61	2. 67	2. 84	3. 10	2. 34
	3 Returns	8. 13	8. 22	8. 24	8. 34	8. 35	8. 44	8. 46	8. 55	8. 56	8. 65	8. 66	8. 75	8. 76	8. 85			
110	Sag	2. 73	2. 79	2. 80	2. 86	2. 87	2. 94	2. 94	3. 01	3. 01	3. 07	3. 08	3. 14	3. 15	3. 21	4. 30	3. 71	2. 83
	3 Returns	8. 95	9. 05	9. 07	9. 17	9. 18	9. 28	9. 29	9. 39	9. 40	9. 50	9. 50	9. 60	9. 61	9. 70			
120	Sag	3. 25	3. 32	3. 34	3. 41	3. 42	3. 49	3. 51	3. 58	3. 59	3. 66	3. 67	3. 74	3. 75	3. 82	4. 05	4. 42	3. 37
	3 Returns	9. 77	9. 87	9. 89	10. 00	10. 02	10. 12	10. 14	10. 24	10. 26	10. 36	10. 37	10. 47	10. 48	10. 59			
130	Sag	3. 83	3. 92	3. 94	4. 03	4. 04	4. 13	4. 15	4. 24	4. 25	4. 34	4. 35	4. 44	4. 44	4. 54	4. 82	5. 27	3. 95
	3 Returns	10. 60	10. 72	10. 75	10. 87	10. 89	11. 01	11. 02	11. 14	11. 16	11. 28	11. 29	11. 40	11. 41	11. 53			
140	Sag	4. 45	4. 55	4. 57	4. 67	4. 68	4. 78	4. 80	4. 90	4. 91	5. 01	5. 02	5. 12	5. 13	5. 23	5. 55	6. 05	4. 58
	3 Returns	11. 42	11. 55	11. 57	11. 69	11. 72	11. 84	11. 86	11. 98	11. 99	12. 12	12. 13	12. 25	12. 26	12. 38			
150	Sag	5. 11	5. 22	5. 24	5. 36	5. 38	5. 49	5. 51	5. 62	5. 63	5. 75	5. 76	5. 88	5. 89	6. 00	6. 37	6. 94	5. 26
	3 Returns	12. 24	12. 37	12. 40	12. 53	12. 55	12. 68	12. 70	12. 83	12. 85	12. 98	12. 99	13. 12	13. 13	13. 26			
CONDUCTOR		TENSION (kN)																
Cu 7/1. 75		0. 86	0. 82	0. 83	0. 80	0. 81	0. 78	0. 79	0. 76	0. 75	0. 75	0. 74	0. 73	0. 72	0. 70	0. 67	0. 61	
Cu 7/2. 00		1. 10	1. 06	1. 07	1. 04	1. 04	1. 01	1. 01	0. 99	0. 99	0. 96	0. 97	0. 94	0. 95	0. 92	0. 86	0. 79	
Cu 7/2. 75		1. 97	1. 94	1. 92	1. 89	1. 88	1. 85	1. 83	1. 80	1. 79	1. 77	1. 76	1. 73	1. 72	1. 69	1. 60	1. 47	
Cu 19/2. 00		2. 92	2. 86	2. 84	2. 78	2. 77	2. 72	2. 71	2. 65	2. 65	2. 59	2. 59	2. 54	2. 53	2. 48	2. 34	2. 14	
Cu 19/3. 00		6. 13	6. 07	5. 99	5. 93	5. 85	5. 80	5. 73	5. 67	5. 61	5. 55	5. 50	5. 44	5. 39	5. 34	5. 05	4. 66	
Cu 37/2. 75		10. 08	10. 02	9. 86	9. 79	9. 64	9. 58	9. 44	9. 37	9. 24	9. 18	9. 06	9. 00	8. 89	8. 83	8. 35	7. 71	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC: 5ºC

8.3 Sheet 79 **HDC (Copper)** **SEMI-URBAN (12% UTS)** **150m RULING SPAN**

		SAG (m) /TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
SPAN LENGTH (m)	ELEMENT	Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
80	Sag	1. 45	1. 49	1. 49	1. 52	1. 53	1. 56	1. 57	1. 60	1. 60	1. 64	1. 64	1. 67	1. 67	1. 71	1. 81	1. 97	1. 34
	3 Returns	6. 53	6. 60	6. 62	6. 69	6. 70	6. 77	6. 78	6. 85	6. 86	6. 93	6. 94	7. 01	7. 01	7. 08			
100	Sag	2. 26	2. 31	2. 32	2. 37	2. 37	2. 42	2. 43	2. 48	2. 49	2. 54	2. 54	2. 60	2. 60	2. 65	2. 81	3. 07	2. 10
	3 Returns	8. 14	8. 23	8. 24	8. 33	8. 35	8. 43	8. 45	8. 53	8. 54	8. 63	8. 64	8. 73	8. 73	8. 82			
120	Sag	3. 25	3. 32	3. 34	3. 41	3. 42	3. 49	3. 51	3. 58	3. 59	3. 66	3. 67	3. 74	3. 75	3. 82	4. 05	4. 42	3. 03
	3 Returns	9. 77	9. 87	9. 89	10. 00	10. 02	10. 12	10. 14	10. 24	10. 26	10. 36	10. 37	10. 47	10. 48	10. 59			
140	Sag	4. 43	4. 53	4. 55	4. 64	4. 66	4. 76	4. 77	4. 87	4. 89	4. 99	5. 00	5. 10	5. 10	5. 21	5. 52	6. 02	4. 12
	3 Returns	11. 40	11. 52	11. 55	11. 67	11. 69	11. 81	11. 83	11. 95	11. 97	12. 09	12. 10	12. 22	12. 23	12. 35			
160	Sag	5. 81	5. 94	5. 97	6. 09	6. 12	6. 25	6. 26	6. 40	6. 41	6. 54	6. 56	6. 69	6. 70	6. 83	7. 25	7. 90	5. 38
	3 Returns	13. 05	13. 19	13. 22	13. 36	13. 39	13. 53	13. 55	13. 69	13. 70	13. 85	13. 86	14. 00	14. 01	14. 15			
180	Sag	7. 36	7. 52	7. 55	7. 72	7. 74	7. 91	7. 93	8. 10	8. 12	8. 29	8. 30	8. 47	8. 48	8. 65	9. 18	10. 01	6. 82
	3 Returns	14. 68	14. 84	14. 87	15. 03	15. 06	15. 22	15. 24	15. 40	15. 42	15. 57	15. 59	15. 75	15. 75	15. 91			
200	Sag	9. 11	9. 29	9. 32	9. 51	9. 54	9. 73	9. 75	9. 94	9. 96	10. 15	10. 17	10. 36	10. 37	10. 57	11. 36	12. 11	8. 42
	3 Returns	16. 33	16. 49	16. 52	16. 69	16. 71	16. 87	16. 89	17. 06	17. 07	17. 24	17. 25	17. 41	17. 42	17. 58			
CONDUCTOR		TENSION (kN)																
Cu 7/1. 75		0. 86	0. 82	0. 83	0. 80	0. 81	0. 78	0. 79	0. 76	0. 77	0. 75	0. 75	0. 73	0. 74	0. 71	0. 67	0. 61	
Cu 7/2. 00		1. 10	1. 06	1. 07	1. 04	1. 04	1. 01	1. 01	0. 99	0. 99	0. 96	0. 97	0. 94	0. 95	0. 92	0. 86	0. 79	
Cu 7/2. 75		1. 97	1. 94	1. 92	1. 89	1. 88	1. 85	1. 83	1. 77	1. 79	1. 73	1. 76	1. 69	1. 72	1. 66	1. 60	1. 47	
Cu 19/2. 00		2. 92	2. 86	2. 82	2. 78	2. 77	2. 72	2. 71	2. 65	2. 65	2. 59	2. 59	2. 54	2. 53	2. 48	2. 34	2. 14	
Cu 19/3. 00		6. 13	6. 07	5. 99	5. 93	5. 85	5. 80	5. 73	5. 67	5. 61	5. 55	5. 50	5. 44	5. 39	5. 34	5. 05	4. 66	
Cu 37/2. 75		10. 08	10. 02	9. 86	9. 79	9. 64	9. 58	9. 44	9. 37	9. 24	9. 18	9. 06	9. 00	8. 89	8. 66	8. 35	7. 71	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC: 5ºC

8.3 Sheet 80 **HDC (Copper)** **RURAL (20% UTS)** **100m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) /TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
60	Sag	0. 81	0. 83	0. 83	0. 85	0. 85	0. 87	0. 87	0. 89	0. 89	0. 91	0. 91	0. 93	0. 93	0. 95	1. 01	1. 10	0. 63
	3 Returns	4. 88	4. 93	4. 94	4. 99	5. 00	5. 06	5. 06	5. 12	5. 12	5. 17	5. 18	5. 23	5. 23	5. 29			
80	Sag	1. 45	1. 49	1. 49	1. 52	1. 53	1. 56	1. 57	1. 60	1. 60	1. 64	1. 64	1. 67	1. 67	1. 71	1. 81	1. 97	1. 12
	3 Returns	6. 53	6. 60	6. 62	6. 69	6. 70	6. 77	6. 78	6. 85	6. 86	6. 93	6. 94	7. 01	7. 01	7. 08			
100	Sag	2. 26	2. 31	2. 32	2. 37	2. 37	2. 42	2. 43	2. 48	2. 49	2. 54	2. 54	2. 60	2. 60	2. 65	2. 81	3. 07	1. 75
	3 Returns	8. 14	8. 23	8. 24	8. 33	8. 35	8. 43	8. 45	8. 53	8. 54	8. 63	8. 64	8. 73	8. 73	8. 82			
120	Sag	3. 25	3. 32	3. 34	3. 41	3. 42	3. 49	3. 51	3. 58	3. 59	3. 66	3. 67	3. 74	3. 75	3. 82	4. 05	4. 42	2. 52
	3 Returns	9. 77	9. 87	9. 89	10. 00	10. 02	10. 12	10. 14	10. 24	10. 26	10. 36	10. 37	10. 47	10. 48	10. 59			
140	Sag	4. 43	4. 53	4. 55	4. 64	4. 66	4. 76	4. 77	4. 87	4. 89	4. 99	5. 00	5. 10	5. 10	5. 21	5. 52	6. 02	3. 43
	3 Returns	11. 40	11. 52	11. 55	11. 67	11. 69	11. 81	11. 83	11. 95	11. 97	12. 09	12. 10	12. 22	12. 23	12. 35			
160	Sag	5. 81	5. 94	5. 97	6. 09	6. 12	6. 25	6. 26	6. 40	6. 41	6. 54	6. 56	6. 69	6. 70	6. 83	7. 25	7. 90	4. 48
	3 Returns	13. 05	13. 19	13. 22	13. 36	13. 39	13. 53	13. 55	13. 69	13. 70	13. 85	13. 86	14. 00	14. 01	14. 15			
180	Sag	7. 36	7. 52	7. 55	7. 72	7. 74	7. 91	7. 93	8. 10	8. 12	8. 29	8. 30	8. 47	8. 48	8. 65	9. 18	10. 01	5. 67
	3 Returns	14. 68	14. 84	14. 87	15. 03	15. 06	15. 22	15. 24	15. 40	15. 42	15. 57	15. 59	15. 75	15. 75	15. 91			
200	Sag	9. 11	9. 29	9. 32	9. 51	9. 54	9. 73	9. 75	9. 94	9. 96	10. 15	10. 17	10. 36	10. 37	10. 57	11. 36	12. 11	7. 01
	3 Returns	16. 33	16. 49	16. 52	16. 69	16. 71	16. 87	16. 89	17. 06	17. 07	17. 24	17. 25	17. 41	17. 42	17. 58			
CONDUCTOR		TENSION (kN)																
Cu 7/1. 75		0. 86	0. 82	0. 83	0. 80	0. 81	0. 78	0. 79	0. 76	0. 77	0. 75	0. 75	0. 73	0. 74	0. 71	0. 67	0. 61	
Cu 7/2. 00		1. 10	1. 06	1. 07	1. 04	1. 04	1. 01	1. 01	0. 99	0. 99	0. 96	0. 97	0. 94	0. 95	0. 92	0. 86	0. 79	
Cu 7/2. 75		1. 97	1. 94	1. 92	1. 89	1. 88	1. 85	1. 83	1. 77	1. 79	1. 73	1. 76	1. 69	1. 72	1. 66	1. 60	1. 47	
Cu 19/2. 00		2. 92	2. 86	2. 82	2. 78	2. 77	2. 72	2. 71	2. 65	2. 65	2. 59	2. 59	2. 54	2. 53	2. 48	2. 34	2. 14	
Cu 19/3. 00		6. 13	6. 07	5. 99	5. 93	5. 85	5. 80	5. 73	5. 67	5. 61	5. 55	5. 50	5. 44	5. 39	5. 34	5. 05	4. 66	
Cu 37/2. 75		10. 08	10. 02	9. 86	9. 79	9. 64	9. 58	9. 44	9. 37	9. 24	9. 18	9. 06	9. 00	8. 89	8. 66	8. 35	7. 71	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC: 5ºC

8.3 Sheet 81 **HDC (Copper)** **RURAL (20% UTS)** **150m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) /TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
80	Sag	0.85	0.88	0.88	0.91	0.90	0.93	0.92	0.96	0.95	0.98	0.97	1.01	0.99	1.03	1.10	1.21	0.95
	3 Returns	5.00	5.09	5.07	5.17	5.14	5.24	5.21	5.30	5.27	5.37	5.34	5.44	5.40	5.50			
100	Sag	1.33	1.38	1.37	1.42	1.41	1.46	1.44	1.50	1.48	1.54	1.52	1.58	1.56	1.61	1.72	1.89	1.49
	3 Returns	6.25	6.37	6.34	6.46	6.43	6.55	6.51	6.63	6.59	6.72	6.68	6.80	6.76	6.88			
120	Sag	1.93	2.00	1.98	2.06	2.04	2.12	2.09	2.17	2.15	2.23	2.20	2.28	2.25	2.34	2.49	2.74	2.14
	3 Returns	7.52	7.66	7.63	7.77	7.73	7.88	7.83	7.98	7.94	8.08	8.03	8.18	8.13	8.28			
140	Sag	2.62	2.72	2.70	2.80	2.77	2.88	2.85	2.95	2.92	3.03	2.99	3.10	3.06	3.18	3.39	3.73	2.91
	3 Returns	8.77	8.94	8.90	9.07	9.02	9.19	9.14	9.43	9.26	9.54	9.37	9.66	9.48	9.77			
160	Sag	3.43	3.56	3.52	3.66	3.62	3.76	3.72	3.86	3.81	3.96	3.91	4.05	4.00	4.15	4.43	4.88	3.81
	3 Returns	10.03	10.21	10.17	10.36	10.31	10.50	10.44	10.64	10.58	10.91	10.71	11.03	10.84	11.16			
180	Sag	4.32	4.49	4.44	4.61	4.57	4.74	4.69	4.87	4.81	4.99	4.93	5.11	5.05	5.24	5.59	6.15	4.82
	3 Returns	11.26	11.47	11.42	11.63	11.57	11.79	11.73	11.95	11.88	12.20	12.02	12.25	12.17	12.39			
200	Sag	5.34	5.54	5.49	5.70	5.64	5.86	5.79	6.01	5.94	6.16	6.09	6.32	6.24	6.47	6.90	7.60	5.95
	3 Returns	12.51	12.75	12.69	12.93	12.86	13.10	13.03	13.28	13.20	13.44	13.36	13.61	13.52	13.77			
220	Sag	6.46	6.71	6.64	6.90	6.83	7.09	7.01	7.28	7.19	7.46	7.37	7.65	7.55	7.83	8.36	9.20	7.20
	3 Returns																	
CONDUCTOR		TENSION (kN)																
Cu 7/1.75		1.50	1.37	1.46	1.33	1.41	1.30	1.37	1.26	1.34	1.23	1.30	1.20	1.27	1.17	1.09	0.99	
Cu 7/2.00		1.90	1.77	1.84	1.72	1.79	1.68	1.74	1.63	1.69	1.59	1.65	1.52	1.61	1.48	1.41	1.28	
Cu 7/2.75		3.34	3.23	3.25	3.14	3.17	3.06	3.09	2.99	3.01	2.92	2.94	2.85	3.87	2.79	2.61	2.38	
Cu 19/2.00		4.95	4.76	4.81	4.63	4.68	4.51	4.56	4.39	4.44	4.28	4.34	4.18	4.23	4.08	3.82	3.47	
Cu 19/3.00		10.29	10.12	10.03	9.86	9.78	9.62	9.55	9.39	9.33	9.17	9.13	8.97	8.93	8.77	8.59	7.54	
Cu 37/2.75		16.99	16.72	16.59	16.30	16.20	15.90	15.83	15.53	15.48	15.17	15.14	14.84	14.83	14.53	13.67	12.50	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC: 7ºC

8.3 Sheet 82 **HDC (Copper)** **RURAL (20% UTS)** **200m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) /TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
100	Sag	1. 35	1. 39	1. 37	1. 41	1. 39	1. 43	1. 42	1. 46	1. 44	1. 48	1. 47	1. 51	1. 49	1. 53	1. 60	1. 71	1. 36
	3 Returns	6. 29	6. 38	6. 34	6. 43	6. 40	6. 49	6. 45	6. 54	6. 51	6. 60	6. 56	6. 65	6. 61	6. 70			
120	Sag	1. 94	2. 00	1. 98	2. 03	2. 01	2. 07	2. 04	2. 10	2. 08	2. 14	2. 11	2. 17	2. 14	2. 20	2. 30	2. 46	1. 95
	3 Returns	7. 55	7. 65	7. 61	7. 72	7. 68	7. 79	7. 74	7. 85	7. 81	7. 92	7. 87	7. 98	7. 93	8. 04			
140	Sag	2. 64	2. 72	2. 69	2. 77	2. 74	2. 81	2. 78	2. 86	2. 83	2. 91	2. 88	2. 95	2. 92	3. 00	3. 13	3. 35	2. 66
	3 Returns	8. 81	8. 93	8. 88	9. 01	8. 96	9. 09	9. 04	9. 16	9. 11	9. 24	9. 18	9. 31	9. 26	9. 38			
160	Sag	3. 45	3. 55	3. 51	3. 62	3. 58	3. 68	3. 64	3. 74	3. 70	3. 80	3. 76	3. 86	3. 82	3. 92	4. 10	4. 38	3. 47
	3 Returns	10. 06	10. 21	10. 15	10. 30	10. 24	10. 39	10. 33	10. 47	10. 41	10. 56	10. 50	10. 64	10. 58	10. 72			
180	Sag	4. 39	4. 51	4. 46	4. 59	4. 54	4. 67	4. 62	4. 75	4. 70	4. 83	4. 77	4. 91	4. 85	4. 98	5. 20	5. 56	4. 40
	3 Returns	11. 34	11. 51	11. 44	11. 61	11. 54	11. 71	11. 64	11. 80	11. 74	11. 90	11. 83	11. 99	11. 92	12. 09			
200	Sag	5. 41	5. 57	5. 51	5. 67	5. 61	5. 77	5. 70	5. 87	5. 80	5. 96	5. 89	6. 06	5. 99	6. 15	6. 43	6. 87	5. 43
	3 Returns	12. 60	12. 78	12. 71	12. 90	12. 83	13. 01	12. 93	13. 11	13. 04	13. 22	13. 15	13. 33	13. 25	13. 43			
220	Sag	6. 55	6. 74	6. 67	6. 86	6. 79	6. 98	6. 90	7. 10	7. 02	7. 21	7. 13	7. 33	7. 24	7. 44	7. 78	8. 31	6. 57
	3 Returns	13. 86	14. 06	13. 99	14. 18	14. 11	14. 31	14. 23	14. 43	14. 34	14. 54	14. 46	14. 66	14. 57	14. 77			
240	Sag	7. 80	8. 03	7. 94	8. 17	8. 08	8. 31	8. 22	8. 45	8. 35	8. 59	8. 49	8. 72	8. 62	8. 86	9. 26	9. 89	7. 82
	3 Returns	15. 12	15. 34	15. 26	15. 47	15. 39	15. 61	15. 52	15. 74	15. 65	15. 86	15. 77	15. 99	15. 90	16. 11			
260	Sag	9. 15	9. 42	9. 32	9. 59	9. 48	9. 75	9. 64	9. 92	9. 80	10. 08	9. 96	10. 24	10. 12	10. 40	10. 87	11. 61	9. 18
	3 Returns	16. 38	16. 62	16. 53	16. 76	16. 67	16. 91	16. 81	17. 05	16. 95	17. 18	17. 09	17. 32	17. 22	17. 45			
CONDUCTOR		TENSION (kN)																
Cu 7/1. 75		1. 48	1. 37	1. 45	1. 35	1. 43	1. 32	1. 40	1. 30	1. 37	1. 28	1. 35	1. 26	1. 33	1. 24	1. 18	1. 10	
Cu 7/2. 00		1. 87	1. 77	1. 83	1. 74	1. 80	1. 71	1. 77	1. 68	1. 74	1. 65	1. 71	1. 62	1. 68	1. 60	1. 52	1. 42	
Cu 7/2. 75		3. 30	3. 22	3. 25	3. 17	3. 20	3. 11	3. 14	3. 07	3. 09	3. 02	3. 05	2. 97	3. 00	2. 93	2. 81	2. 63	
Cu 19/2. 00		4. 89	4. 75	4. 80	4. 67	4. 72	4. 59	4. 64	4. 51	4. 57	4. 44	4. 49	4. 37	4. 42	4. 31	4. 10	3. 85	
Cu 19/3. 00		10. 21	10. 09	10. 05	9. 93	9. 90	9. 78	9. 75	9. 63	9. 61	9. 49	9. 47	9. 35	9. 34	9. 22	8. 85	8. 32	
Cu 37/2. 75		16. 89	16. 67	16. 63	16. 40	16. 38	16. 15	16. 14	15. 91	15. 90	15. 68	15. 68	15. 46	15. 46	15. 24	14. 64	13. 77	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC: 8ºC

8.3 Sheet 83 **HDC (Copper)** **RURAL (20% UTS)** **250m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) /TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
120	Sag	1. 96	2. 00	1. 98	2. 03	2. 01	2. 05	2. 03	2. 07	2. 05	2. 10	2. 08	2. 12	2. 10	2. 14	2. 21	2. 32	1. 67
	3 Returns	7. 59	7. 67	7. 63	7. 71	7. 68	7. 76	7. 72	7. 80	7. 76	7. 85	7. 81	7. 89	7. 85	7. 93			
140	Sag	2. 67	2. 73	2. 70	2. 76	2. 73	2. 79	2. 77	2. 82	2. 80	2. 86	2. 83	2. 89	2. 86	2. 92	3. 01	3. 15	2. 27
	3 Returns	8. 85	8. 95	8. 91	9. 00	8. 96	9. 05	9. 01	9. 10	9. 06	9. 15	9. 11	9. 20	9. 16	9. 25			
160	Sag	3. 49	3. 57	3. 53	3. 61	3. 57	3. 65	3. 61	3. 69	3. 66	3. 73	3. 70	3. 77	3. 74	3. 81	3. 93	4. 13	2. 96
	3 Returns	10. 12	10. 23	10. 18	10. 29	10. 24	10. 35	10. 30	10. 41	10. 36	10. 46	10. 41	10. 52	10. 53	10. 58			
180	Sag	4. 42	4. 51	4. 47	4. 57	4. 52	4. 62	4. 58	4. 67	4. 63	4. 73	4. 68	4. 78	4. 73	4. 83	4. 98	5. 23	3. 75
	3 Returns	11. 38	11. 51	11. 45	11. 57	11. 52	11. 64	11. 59	11. 71	11. 65	11. 77	11. 72	11. 84	11. 78	11. 90			
200	Sag	5. 47	5. 59	5. 54	5. 66	5. 60	5. 72	5. 67	5. 79	5. 73	5. 85	5. 80	5. 92	5. 86	5. 98	6. 17	6. 47	4. 63
	3 Returns	12. 67	12. 81	12. 75	12. 88	12. 82	12. 96	12. 89	13. 03	12. 97	13. 10	13. 04	13. 17	13. 11	13. 24			
220	Sag	6. 62	6. 77	6. 70	6. 85	6. 78	6. 93	6. 86	7. 01	6. 94	7. 08	7. 02	7. 16	7. 09	7. 24	7. 47	7. 98	5. 61
	3 Returns	13. 94	14. 09	14. 02	14. 17	14. 10	14. 25	14. 18	14. 33	14. 26	14. 41	14. 34	14. 49	14. 42	14. 57			
240	Sag	7. 88	8. 05	7. 98	8. 15	8. 07	8. 24	8. 17	8. 34	8. 26	8. 43	8. 35	8. 52	8. 44	8. 61	8. 88	9. 31	6. 67
	3 Returns	15. 20	15. 37	15. 29	15. 46	15. 38	15. 54	15. 47	15. 63	15. 56	15. 72	15. 64	15. 80	15. 73	15. 89			
260	Sag	9. 25	9. 45	9. 36	9. 57	9. 48	9. 68	9. 59	9. 79	9. 69	9. 90	9. 80	10. 01	9. 91	10. 11	10. 43	10. 95	7. 83
	3 Returns	16. 47	16. 64	16. 57	16. 74	16. 66	16. 84	16. 76	16. 94	16. 85	17. 03	16. 95	17. 12	17. 04	17. 21			
CONDUCTOR		TENSION (kN)																
Cu 7/1. 75		1. 14	1. 09	1. 12	1. 09	1. 11	1. 07	1. 09	1. 05	1. 08	1. 04	1. 07	1. 03	1. 05	1. 02	0. 98	0. 93	
Cu 7/2. 00		1. 45	1. 41	1. 43	1. 39	1. 41	1. 38	1. 40	1. 36	1. 38	1. 34	1. 36	1. 33	1. 35	1. 31	1. 27	1. 21	
Cu 7/2. 75		2. 60	2. 57	2. 57	2. 54	2. 54	2. 51	2. 51	2. 48	2. 49	2. 45	2. 46	2. 43	2. 44	2. 40	2. 33	2. 22	
Cu 19/2. 00		4. 95	4. 76	4. 81	4. 63	4. 68	4. 51	4. 56	4. 39	4. 44	4. 28	4. 34	4. 18	4. 23	4. 08	3. 82	3. 47	
Cu 19/3. 00		10. 29	10. 12	10. 03	9. 86	9. 78	9. 62	9. 55	9. 39	9. 33	9. 17	9. 13	8. 97	8. 93	8. 77	8. 59	7. 54	
Cu 37/2. 75		16. 99	16. 72	16. 59	16. 30	16. 20	15. 90	15. 83	15. 53	15. 48	15. 17	15. 14	14. 84	14. 83	14. 53	13. 67	12. 50	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC: 9ºC

Steel

8.3 Sheet 84 **STEEL** **SEMI-URBAN (12% UTS)** **50m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																
SPAN LENGTH (m)	ELEMENT	Temperature																BLOWOUT (m)
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
20	Sag	0. 02	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 03	0. 04	0. 04	0. 04	0. 05	0. 08	0. 05
	3 Returns	0. 85	0. 86	0. 88	0. 89	0. 91	0. 92	0. 94	0. 96	0. 97	1. 00	1. 00	1. 04	1. 04	1. 08			
30	Sag	0. 06	0. 06	0. 06	0. 06	0. 06	0. 07	0. 07	0. 07	0. 07	0. 08	0. 08	0. 08	0. 08	0. 09	0. 12	0. 18	0. 12
	3 Returns	1. 29	1. 30	1. 32	1. 34	1. 36	1. 39	1. 41	1. 44	1. 45	1. 50	1. 51	1. 56	1. 56	1. 62			
40	Sag	0. 10	0. 10	0. 11	0. 11	0. 11	0. 12	0. 12	0. 13	0. 13	0. 14	0. 14	0. 15	0. 15	0. 16	0. 22	0. 34	0. 21
	3 Returns	1. 72	1. 73	1. 77	1. 79	1. 83	1. 86	1. 89	1. 93	1. 95	2. 01	2. 02	2. 09	2. 10	2. 19			
50	Sag	0. 16	0. 16	0. 17	0. 17	0. 18	0. 18	0. 19	0. 20	0. 20	0. 21	0. 22	0. 23	0. 23	0. 25	0. 33	0. 49	0. 32
	3 Returns	2. 15	2. 17	2. 21	2. 24	2. 28	2. 32	2. 35	2. 41	2. 43	2. 50	2. 51	2. 60	2. 61	2. 71			
60	Sag	0. 23	0. 23	0. 24	0. 25	0. 26	0. 27	0. 27	0. 29	0. 29	0. 31	0. 31	0. 34	0. 34	0. 37	0. 48	0. 72	0. 46
	3 Returns	2. 59	2. 62	2. 67	2. 70	2. 75	2. 80	2. 84	2. 90	2. 93	3. 02	3. 03	3. 14	3. 14	3. 27			
70	Sag	0. 31	0. 32	0. 33	0. 34	0. 35	0. 36	0. 37	0. 39	0. 40	0. 42	0. 43	0. 46	0. 46	0. 50	0. 65	0. 98	0. 63
	3 Returns	3. 02	3. 05	3. 11	3. 15	3. 21	3. 26	3. 31	3. 39	3. 42	3. 52	3. 54	3. 66	3. 67	3. 82			
80	Sag	0. 41	0. 41	0. 43	0. 44	0. 46	0. 48	0. 49	0. 51	0. 53	0. 55	0. 56	0. 60	0. 61	0. 66	0. 88	1. 39	0. 82
	3 Returns	3. 46	3. 49	3. 56	3. 61	3. 67	3. 73	3. 80	3. 88	3. 93	4. 03	4. 07	4. 21	4. 22	4. 40			
90	Sag	0. 51	0. 52	0. 54	0. 56	0. 58	0. 60	0. 62	0. 64	0. 66	0. 70	0. 70	0. 75	0. 76	0. 82	1. 07	1. 62	1. 04
	3 Returns	3. 88	3. 92	4. 00	4. 05	4. 12	4. 20	4. 25	4. 35	4. 39	4. 52	4. 55	4. 71	4. 71	4. 91			
100	Sag	0. 63	0. 65	0. 67	0. 69	0. 71	0. 74	0. 76	0. 80	0. 81	0. 86	0. 87	0. 93	0. 93	1. 01	1. 32	2. 00	1. 29
	3 Returns	4. 31	4. 36	4. 44	4. 50	4. 58	4. 66	4. 72	4. 83	4. 88	5. 02	5. 05	5. 23	5. 24	5. 45			
CONDUCTOR		TENSION (kN)																
3/2. 00 SC/GZ		1. 45	1. 40	1. 37	1. 32	1. 29	1. 23	1. 21	1. 15	1. 14	1. 06	1. 07	0. 98	0. 99	0. 91	0. 70	0. 46	
3/2. 75 SC/GZ		2. 72	2. 66	2. 57	2. 49	2. 41	2. 33	2. 27	2. 16	2. 12	2. 00	1. 98	1. 85	1. 84	1. 70	1. 31	0. 86	
7/3. 25 SC/GZ		8. 68	8. 68	8. 19	8. 14	7. 72	7. 61	7. 25	7. 09	6. 79	6. 58	6. 35	6. 08	5. 92	5. 61	4. 33	2. 88	
7/3. 75 SC/GZ		10. 95	10. 95	10. 32	10. 25	9. 70	9. 56	9. 10	8. 88	8. 51	8. 23	7. 94	7. 60	7. 39	7. 00	5. 42	3. 69	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC:3ºC

8.3 Sheet 85 STEEL SEMI-URBAN (12% UTS) 75m RULING SPAN

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0.15	0.16	0.16	0.17	0.17	0.18	0.18	0.19	0.19	0.21	0.21	0.22	0.22	0.24	0.29	0.39	0.28
	3 Returns	2.13	2.17	2.19	2.24	2.25	2.31	2.32	2.38	2.38	2.46	2.46	2.55	2.53	2.63			
60	Sag	0.22	0.23	0.24	0.25	0.25	0.26	0.26	0.28	0.28	0.30	0.30	0.32	0.31	0.34	0.42	0.56	0.40
	3 Returns	2.56	2.60	2.63	2.68	2.70	2.77	2.78	2.86	2.86	2.96	2.95	3.06	3.04	3.16			
70	Sag	0.30	0.31	0.32	0.33	0.34	0.36	0.36	0.38	0.38	0.41	0.40	0.43	0.43	0.46	0.57	0.77	0.54
	3 Returns	2.99	3.04	3.07	3.13	3.15	3.23	3.24	3.34	3.34	3.45	3.44	3.57	3.55	3.69			
80	Sag	0.40	0.41	0.42	0.44	0.44	0.46	0.47	0.50	0.50	0.53	0.53	0.57	0.56	0.61	0.74	1.00	0.71
	3 Returns	3.41	3.47	3.51	3.58	3.60	3.69	3.71	3.82	3.82	3.94	3.93	4.08	4.05	4.22			
90	Sag	0.50	0.52	0.53	0.55	0.56	0.59	0.59	0.63	0.63	0.67	0.67	0.72	0.71	0.77	0.94	1.27	0.90
	3 Returns	3.84	3.91	3.95	4.03	4.06	4.16	4.17	4.29	4.30	4.44	4.43	4.59	4.56	4.75			
100	Sag	0.62	0.65	0.66	0.69	0.70	0.73	0.74	0.78	0.78	0.83	0.83	0.89	0.88	0.95	1.17	1.58	1.11
	3 Returns	4.28	4.36	4.40	4.49	4.52	4.63	4.65	4.79	4.79	4.95	4.93	5.12	5.09	5.29			
110	Sag	0.76	0.78	0.80	0.83	0.84	0.88	0.89	0.94	0.95	1.01	1.00	1.08	1.07	1.15	1.41	1.91	1.34
	3 Returns	4.71	4.79	4.84	4.94	4.97	5.10	5.12	5.26	5.27	5.44	5.43	5.63	5.59	5.82			
120	Sag	0.90	0.93	0.95	0.99	1.00	1.05	1.06	1.12	1.12	1.20	1.19	1.28	1.27	1.37	1.68	2.27	1.60
	3 Returns	5.14	5.23	5.28	5.39	5.42	5.56	5.58	5.74	5.75	5.93	5.92	6.14	6.10	6.35			
130	Sag	1.05	1.09	1.11	1.16	1.18	1.24	1.24	1.32	1.32	1.41	1.40	1.51	1.49	1.61	1.97	2.66	1.88
	3 Returns	5.56	5.66	5.72	5.84	5.88	6.02	6.04	6.22	6.22	6.43	6.41	6.65	6.61	6.88			
140	Sag	1.22	1.27	1.29	1.35	1.36	1.43	1.44	1.53	1.53	1.63	1.62	1.75	1.73	1.87	2.29	3.09	2.18
	3 Returns	5.99	6.10	6.15	6.28	6.33	6.48	6.51	6.70	6.70	6.92	6.90	7.16	7.12	7.41			
150	Sag	1.40	1.45	1.48	1.54	1.57	1.64	1.66	1.75	1.76	1.87	1.86	2.00	1.98	2.15	2.63	3.55	2.50
	3 Returns	6.42	6.53	6.59	6.73	6.78	6.95	6.97	7.17	7.18	7.42	7.40	7.67	7.62	7.94			
CONDUCTOR		TENSION (kN)																
3/2.00 SC/GZ		1.47	1.40	1.39	1.32	1.32	1.24	1.25	1.17	1.18	1.09	1.11	1.02	1.05	0.96	0.78	0.58	
3/2.75 SC/GZ		2.76	2.66	2.61	2.51	2.47	2.35	2.34	2.21	2.20	2.07	2.08	1.93	1.95	1.80	1.47	1.09	
7/3.25 SC/GZ		8.76	8.67	8.30	8.18	7.86	7.69	7.43	7.22	7.01	6.77	6.62	6.34	6.23	5.93	4.86	3.62	
7/3.75 SC/GZ		11.04	10.95	10.45	10.31	9.89	9.70	9.34	9.10	8.82	8.53	8.32	8.00	7.84	7.49	6.19	4.69	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:5ºC

8.3 Sheet 86 **STEEL** **SEMI-URBAN (12% UTS)** **100m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
50	Sag	0. 15	0. 16	0. 16	0. 17	0. 17	0. 18	0. 18	0. 19	0. 19	0. 20	0. 20	0. 21	0. 21	0. 22	0. 26	0. 33	0. 25
	3 Returns	2. 12	2. 17	2. 17	2. 23	2. 23	2. 29	2. 29	2. 36	2. 34	2. 42	2. 41	2. 49	2. 47	2. 56			
60	Sag	0. 22	0. 23	0. 23	0. 24	0. 24	0. 26	0. 26	0. 27	0. 27	0. 29	0. 28	0. 31	0. 30	0. 32	0. 38	0. 48	0. 36
	3 Returns	2. 55	2. 60	2. 61	2. 68	2. 68	2. 75	2. 74	2. 83	2. 82	2. 91	2. 89	2. 99	2. 96	3. 08			
80	Sag	0. 39	0. 41	0. 41	0. 43	0. 43	0. 46	0. 46	0. 49	0. 48	0. 51	0. 51	0. 54	0. 53	0. 57	0. 68	0. 85	0. 63
	3 Returns	3. 40	3. 47	3. 48	3. 57	3. 57	3. 67	3. 66	3. 77	3. 76	3. 88	3. 85	3. 99	3. 95	4. 11			
100	Sag	0. 61	0. 64	0. 65	0. 68	0. 68	0. 72	0. 71	0. 76	0. 75	0. 80	0. 79	0. 85	0. 83	0. 90	1. 06	1. 34	0. 99
	3 Returns	4. 25	4. 34	4. 35	4. 46	4. 46	4. 59	4. 58	4. 72	4. 70	4. 85	4. 82	4. 99	4. 95	5. 13			
120	Sag	0. 89	0. 93	0. 94	0. 98	0. 98	1. 04	1. 03	1. 10	1. 09	1. 16	1. 15	1. 23	1. 21	1. 30	1. 53	1. 94	1. 43
	3 Returns	5. 11	5. 23	5. 24	5. 37	5. 37	5. 52	5. 51	5. 68	5. 65	5. 84	5. 80	6. 01	5. 95	6. 18			
140	Sag	1. 21	1. 27	1. 27	1. 34	1. 34	1. 41	1. 41	1. 50	1. 48	1. 58	1. 56	1. 67	1. 64	1. 77	2. 08	2. 63	1. 94
	3 Returns	5. 96	6. 10	6. 11	6. 27	6. 27	6. 44	6. 43	6. 63	6. 59	6. 81	6. 76	7. 01	6. 94	7. 21			
160	Sag	1. 58	1. 65	1. 66	1. 75	1. 75	1. 85	1. 84	1. 95	1. 93	2. 07	2. 04	2. 19	2. 14	2. 31	2. 72	3. 44	2. 54
	3 Returns	6. 81	6. 97	6. 98	7. 16	7. 16	7. 36	7. 34	7. 57	7. 53	7. 79	7. 73	8. 01	7. 93	8. 24			
180	Sag	2. 00	2. 09	2. 10	2. 21	2. 21	2. 34	2. 32	2. 47	2. 45	2. 61	2. 58	2. 77	2. 71	2. 92	3. 44	4. 35	3. 22
	3 Returns	7. 67	7. 84	7. 86	8. 05	8. 05	8. 28	8. 26	8. 52	8. 47	8. 76	8. 70	9. 01	8. 92	9. 26			
200	Sag	2. 47	2. 58	2. 60	2. 73	2. 73	2. 88	2. 87	3. 05	3. 02	3. 23	3. 18	3. 41	3. 35	3. 61	4. 25	5. 38	3. 97
	3 Returns	8. 52	8. 71	8. 73	8. 95	8. 95	9. 20	9. 18	9. 46	9. 42	9. 73	9. 66	10. 01	9. 91	10. 29			
CONDUCTOR		TENSION (kN)																
3/2. 00 SC/GZ		1. 48	1. 40	1. 41	1. 33	1. 34	1. 26	1. 28	1. 19	1. 22	1. 13	1. 16	1. 07	1. 10	1. 01	0. 86	0. 68	
3/2. 75 SC/GZ		2. 78	2. 66	2. 65	2. 52	2. 52	2. 39	2. 40	2. 26	2. 28	2. 13	2. 16	2. 02	2. 05	1. 91	1. 62	1. 28	
7/3. 25 SC/GZ		8. 81	8. 67	8. 39	8. 22	7. 99	7. 79	7. 60	7. 37	7. 23	6. 98	6. 87	6. 61	6. 54	6. 25	5. 33	4. 22	
7/3. 75 SC/GZ		11. 10	10. 95	10. 57	10. 38	10. 07	9. 84	9. 58	9. 33	9. 12	8. 84	8. 68	8. 38	8. 27	7. 95	6. 84	5. 50	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:6ºC

8.3 Sheet 87 STEEL SEMI-URBAN (12% UTS) 150m RULING SPAN

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
80	Sag	0. 39	0. 41	0. 41	0. 43	0. 42	0. 45	0. 44	0. 47	0. 46	0. 49	0. 47	0. 51	0. 49	0. 53	0. 59	0. 69	0. 54
	3 Returns	3. 38	3. 47	3. 45	3. 55	3. 52	3. 63	3. 59	3. 70	3. 66	3. 78	3. 73	3. 86	3. 80	3. 93			
100	Sag	0. 61	0. 64	0. 63	0. 67	0. 66	0. 70	0. 69	0. 73	0. 71	0. 76	0. 74	0. 79	0. 77	0. 82	0. 92	1. 09	0. 84
	3 Returns	4. 23	4. 34	4. 31	4. 44	4. 40	4. 53	4. 49	4. 63	4. 58	4. 73	4. 67	4. 82	4. 76	4. 92			
120	Sag	0. 88	0. 93	0. 91	0. 97	0. 95	1. 01	0. 99	1. 05	1. 03	1. 10	1. 07	1. 14	1. 11	1. 19	1. 33	1. 57	1. 22
	3 Returns	5. 07	5. 22	5. 18	5. 33	5. 28	5. 44	5. 39	5. 56	5. 49	5. 67	5. 60	5. 79	5. 71	5. 90			
140	Sag	1. 19	1. 26	1. 24	1. 32	1. 29	1. 37	1. 35	1. 43	1. 40	1. 49	1. 46	1. 55	1. 51	1. 62	1. 81	2. 13	1. 65
	3 Returns	5. 92	6. 09	6. 04	6. 22	6. 16	6. 35	6. 29	6. 48	6. 41	6. 62	6. 54	6. 75	6. 66	6. 89			
160	Sag	1. 56	1. 65	1. 62	1. 72	1. 69	1. 79	1. 76	1. 87	1. 83	1. 95	1. 90	2. 03	1. 98	2. 11	2. 36	2. 78	2. 16
	3 Returns	6. 77	6. 96	6. 91	7. 11	7. 04	7. 26	7. 19	7. 41	7. 33	7. 57	7. 47	7. 72	7. 62	7. 87			
180	Sag	1. 98	2. 09	2. 06	2. 19	2. 15	2. 28	2. 23	2. 38	2. 32	2. 48	2. 42	2. 58	2. 51	2. 68	3. 00	3. 54	2. 74
	3 Returns	7. 63	7. 84	7. 78	8. 01	7. 94	8. 18	8. 10	8. 35	8. 26	8. 53	8. 42	8. 70	8. 58	8. 87			
200	Sag	2. 45	2. 58	2. 55	2. 70	2. 65	2. 81	2. 76	2. 93	2. 87	3. 06	2. 98	3. 18	3. 10	3. 31	3. 71	4. 37	3. 38
	3 Returns	8. 48	8. 71	8. 65	8. 90	8. 82	9. 09	9. 00	9. 28	9. 18	9. 47	9. 36	9. 67	9. 54	9. 86			
220	Sag	2. 96	3. 13	3. 08	3. 26	3. 21	3. 40	3. 34	3. 55	3. 47	3. 70	3. 61	3. 85	3. 75	4. 01	4. 48	5. 28	4. 09
	3 Returns	9. 32	9. 58	9. 51	9. 79	9. 70	10. 00	9. 90	10. 21	10. 09	10. 42	10. 29	10. 63	10. 49	10. 85			
240	Sag	3. 52	3. 72	3. 67	3. 88	3. 82	4. 05	3. 97	4. 23	4. 13	4. 40	4. 29	4. 58	4. 46	4. 77	5. 34	6. 29	4. 86
	3 Returns	10. 17	10. 45	10. 37	10. 68	10. 58	10. 90	10. 80	11. 14	11. 01	11. 37	11. 23	11. 60	11. 44	11. 83			
260	Sag	4. 13	4. 37	4. 30	4. 56	4. 48	4. 76	4. 66	4. 96	4. 85	5. 17	5. 04	5. 38	5. 24	5. 60	6. 26	7. 38	5. 71
	3 Returns	11. 02	11. 32	11. 24	11. 56	11. 47	11. 81	11. 69	12. 06	11. 93	12. 31	12. 16	12. 56	12. 40	12. 82			
280	Sag	4. 80	5. 06	4. 99	5. 29	5. 19	5. 51	5. 41	5. 75	5. 62	5. 99	5. 85	6. 24	6. 07	6. 49	7. 26	8. 56	6. 62
	3 Returns	11. 86	12. 19	12. 10	12. 45	12. 35	12. 72	12. 59	12. 99	12. 84	13. 26	13. 10	13. 53	13. 35	13. 80			
300	Sag	5. 50	5. 81	5. 73	6. 07	5. 96	6. 33	6. 20	6. 60	6. 45	6. 88	6. 71	7. 16	6. 97	7. 45	8. 34	9. 83	7. 60
	3 Returns	12. 71	13. 06	12. 97	13. 34	13. 23	13. 63	13. 49	13. 92	13. 76	14. 21	14. 03	14. 50	14. 30	14. 79			
CONDUCTOR		TENSION (kN)																
3/2. 00 SC/GZ		1. 49	1. 40	1. 43	1. 35	1. 38	1. 29	1. 33	1. 24	1. 27	1. 19	1. 23	1. 14	1. 18	1. 10	0. 98	0. 84	
3/2. 75 SC/GZ		2. 81	2. 66	2. 70	2. 55	2. 60	2. 44	2. 49	2. 34	2. 40	2. 25	2. 31	2. 16	2. 22	2. 08	1. 86	1. 58	
7/3. 25 SC/GZ		8. 86	8. 67	8. 52	8. 31	8. 19	7. 98	7. 88	7. 66	7. 59	7. 35	7. 31	7. 07	7. 04	6. 80	6. 09	5. 18	
7/3. 75 SC/GZ		11. 15	10. 95	10. 74	10. 51	10. 34	10. 11	9. 97	9. 72	9. 61	9. 36	9. 28	9. 01	8. 96	8. 69	7. 84	6. 75	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:7ºC

8.3 Sheet 88 **STEEL** **RURAL (22. 5% UTS)** **100m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																
SPAN LENGTH (m)	ELEMENT	Temperature																BLOWOUT (m)
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
60	Sag	0. 12	0. 12	0. 13	0. 13	0. 13	0. 13	0. 13	0. 14	0. 14	0. 14	0. 14	0. 15	0. 15	0. 16	0. 18	0. 23	0. 31
	3 Returns	1. 89	1. 90	1. 92	1. 94	1. 95	1. 97	1. 98	2. 01	2. 02	2. 05	2. 06	2. 09	2. 09	2. 13			
70	Sag	0. 17	0. 17	0. 17	0. 17	0. 18	0. 18	0. 18	0. 19	0. 19	0. 19	0. 20	0. 20	0. 20	0. 21	0. 24	0. 31	0. 42
	3 Returns	2. 20	2. 22	2. 24	2. 26	2. 28	2. 30	2. 31	2. 34	2. 36	2. 39	2. 40	2. 44	2. 44	2. 49			
80	Sag	0. 22	0. 22	0. 22	0. 23	0. 23	0. 24	0. 24	0. 24	0. 25	0. 25	0. 26	0. 26	0. 27	0. 28	0. 32	0. 41	0. 55
	3 Returns	2. 52	2. 54	2. 56	2. 58	2. 60	2. 63	2. 65	2. 68	2. 69	2. 73	2. 74	2. 79	2. 79	2. 85			
90	Sag	0. 27	0. 28	0. 28	0. 29	0. 29	0. 30	0. 30	0. 31	0. 31	0. 32	0. 32	0. 34	0. 34	0. 35	0. 40	0. 51	0. 70
	3 Returns	2. 83	2. 85	2. 88	2. 91	2. 93	2. 96	2. 98	3. 02	3. 03	3. 08	3. 09	3. 14	3. 14	3. 20			
100	Sag	0. 34	0. 34	0. 35	0. 36	0. 36	0. 37	0. 37	0. 38	0. 39	0. 40	0. 40	0. 41	0. 42	0. 43	0. 49	0. 64	0. 86
	3 Returns	3. 15	3. 17	3. 20	3. 23	3. 25	3. 29	3. 31	3. 35	3. 37	3. 42	3. 43	3. 49	3. 49	3. 56			
110	Sag	0. 41	0. 41	0. 42	0. 43	0. 44	0. 45	0. 45	0. 46	0. 47	0. 48	0. 48	0. 50	0. 50	0. 52	0. 60	0. 77	1. 04
	3 Returns	3. 46	3. 49	3. 52	3. 55	3. 58	3. 62	3. 64	3. 69	3. 70	3. 76	3. 77	3. 84	3. 84	3. 92			
120	Sag	0. 49	0. 49	0. 50	0. 51	0. 52	0. 53	0. 54	0. 55	0. 56	0. 57	0. 58	0. 60	0. 60	0. 62	0. 71	0. 92	1. 24
	3 Returns	3. 78	3. 81	3. 84	3. 88	3. 90	3. 95	3. 97	4. 02	4. 04	4. 10	4. 12	4. 19	4. 19	4. 27			
130	Sag	0. 57	0. 58	0. 59	0. 60	0. 61	0. 63	0. 63	0. 65	0. 66	0. 68	0. 68	0. 70	0. 71	0. 73	0. 84	1. 08	1. 45
	3 Returns	4. 10	4. 13	4. 17	4. 21	4. 24	4. 29	4. 31	4. 37	4. 39	4. 45	4. 47	4. 55	4. 55	4. 64			
140	Sag	0. 67	0. 68	0. 69	0. 70	0. 71	0. 73	0. 73	0. 75	0. 76	0. 78	0. 79	0. 82	0. 82	0. 85	0. 97	1. 25	1. 68
	3 Returns	4. 42	4. 45	4. 49	4. 53	4. 57	4. 62	4. 64	4. 70	4. 73	4. 80	4. 81	4. 90	4. 90	5. 00			
150	Sag	0. 76	0. 78	0. 79	0. 80	0. 82	0. 83	0. 84	0. 87	0. 87	0. 90	0. 91	0. 94	0. 94	0. 98	1. 12	1. 44	1. 93
	3 Returns	4. 73	4. 77	4. 81	4. 86	4. 89	4. 95	4. 98	5. 04	5. 06	5. 14	5. 16	5. 24	5. 25	5. 36			
160	Sag	0. 87	0. 88	0. 90	0. 91	0. 93	0. 95	0. 96	0. 98	0. 99	1. 02	1. 03	1. 07	1. 07	1. 11	1. 27	1. 64	2. 20
	3 Returns	5. 05	5. 09	5. 13	5. 18	5. 22	5. 27	5. 31	5. 38	5. 40	5. 48	5. 50	5. 59	5. 60	5. 71			
170	Sag	0. 98	1. 00	1. 01	1. 03	1. 05	1. 07	1. 08	1. 11	1. 12	1. 16	1. 16	1. 20	1. 21	1. 25	1. 43	1. 85	2. 48
	3 Returns	5. 37	5. 41	5. 45	5. 50	5. 54	5. 60	5. 64	5. 71	4. 74	5. 82	5. 84	5. 94	5. 95	6. 07			
CONDUCTOR		TENSION (kN)																
3/2. 00 SC/GZ		2. 68	2. 63	2. 60	2. 54	2. 51	2. 45	2. 43	2. 36	2. 34	2. 28	2. 26	2. 19	2. 18	2. 10	1. 84	1. 44	
3/2. 75 SC/GZ		5. 07	4. 99	4. 91	4. 82	4. 75	4. 65	4. 59	4. 47	4. 43	4. 30	4. 27	4. 13	4. 12	3. 96	3. 46	2. 69	
7/3. 25 SC/GZ		16. 28	16. 27	15. 76	15. 71	15. 24	15. 16	14. 72	14. 61	14. 21	14. 07	13. 70	13. 53	13. 20	12. 99	11. 40	8. 93	
7/3. 75 SC/GZ		20. 54	20. 54	19. 85	19. 81	19. 17	19. 09	18. 50	18. 36	17. 83	17. 65	17. 16	16. 94	16. 50	16. 24	14. 18	11. 04	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC:3ºC

8.3 Sheet 89 **STEEL** **RURAL (22. 5% UTS)** **150m RULING SPAN**

		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																
SPAN LENGTH (m)	ELEMENT	Temperature																BLOWOUT (m)
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
80	Sag	0. 21	0. 22	0. 22	0. 23	0. 23	0. 23	0. 23	0. 24	0. 24	0. 25	0. 25	0. 26	0. 26	0. 27	0. 31	0. 38	0. 49
	3 Returns	2. 50	2. 54	2. 54	2. 58	2. 58	2. 63	2. 62	2. 67	2. 66	2. 72	2. 70	2. 77	2. 75	2. 83			
100	Sag	0. 33	0. 34	0. 34	0. 35	0. 35	0. 37	0. 36	0. 38	0. 38	0. 39	0. 39	0. 41	0. 40	0. 43	0. 48	0. 59	0. 77
	3 Returns	3. 12	3. 17	3. 17	3. 23	3. 22	3. 28	3. 27	3. 34	3. 33	3. 40	3. 38	3. 47	3. 44	3. 53			
120	Sag	0. 48	0. 49	0. 49	0. 51	0. 51	0. 53	0. 53	0. 55	0. 54	0. 57	0. 56	0. 59	0. 58	0. 61	0. 69	0. 85	1. 10
	3 Returns	3. 75	3. 81	3. 81	3. 87	3. 87	3. 94	3. 93	4. 01	3. 99	4. 08	4. 06	4. 16	4. 13	4. 24			
140	Sag	0. 65	0. 67	0. 67	0. 70	0. 69	0. 72	0. 72	0. 75	0. 74	0. 77	0. 76	0. 80	0. 79	0. 83	0. 94	1. 16	1. 50
	3 Returns	4. 37	4. 44	4. 44	4. 52	4. 51	4. 60	4. 58	4. 68	4. 66	4. 77	4. 74	4. 86	4. 82	4. 95			
160	Sag	0. 85	0. 88	0. 88	0. 91	0. 91	0. 94	0. 93	0. 97	0. 97	1. 01	1. 00	1. 05	1. 03	1. 09	1. 23	1. 52	1. 96
	3 Returns	5. 00	5. 08	5. 08	5. 16	5. 15	5. 26	5. 24	5. 35	5. 32	5. 45	5. 41	5. 55	5. 51	5. 66			
180	Sag	1. 08	1. 11	1. 11	1. 15	1. 15	1. 19	1. 18	1. 23	1. 22	1. 28	1. 26	1. 33	1. 31	1. 38	1. 55	1. 92	2. 48
	3 Returns	5. 63	5. 71	5. 71	5. 81	5. 80	5. 91	5. 89	6. 02	5. 99	6. 13	6. 09	6. 24	6. 20	6. 36			
200	Sag	1. 33	1. 38	1. 38	1,42	1. 42	1. 48	1. 47	1. 53	1. 51	1. 59	1. 57	1. 65	1. 62	1. 71	1. 93	2. 38	3. 07
	3 Returns	6. 26	6. 36	6. 36	6. 47	6. 46	6. 58	6. 56	6. 70	6. 67	6. 82	6. 78	6. 95	6. 90	7. 08			
220	Sag	1. 61	1. 67	1. 66	1. 72	1. 72	1. 78	1. 77	1. 85	1. 83	1. 92	1. 89	1. 99	1. 96	2. 07	2. 33	2. 87	3. 71
	3 Returns	6. 88	6. 99	6. 99	7. 11	7. 10	7. 24	7. 21	7. 37	7. 33	7. 50	7. 46	7. 64	7. 58	7. 79			
240	Sag	1. 92	1. 98	1. 98	2. 05	2. 04	2. 12	2. 11	2. 20	2. 18	2. 28	2. 25	2. 37	2. 33	2. 46	2. 77	3. 42	4. 42
	3 Returns	7. 51	7. 63	7. 63	7. 76	7. 75	7. 90	7. 87	8. 04	8. 00	8. 18	8. 13	8. 34	8. 27	8. 50			
260	Sag	2. 26	2. 33	2. 32	2. 41	2. 40	2. 49	2. 48	2. 58	2. 56	2. 68	2. 65	2. 78	2. 74	2. 89	3. 25	4. 02	5. 18
	3 Returns	8. 14	8. 26	8. 26	8. 41	8. 39	8. 55	8. 53	8. 71	8. 67	8. 87	8. 81	9. 03	8. 96	9. 21			
280	Sag	2. 62	2. 70	2. 70	2. 79	2. 78	2. 89	2. 87	2. 99	2. 97	3. 11	3. 07	3. 22	3. 17	3. 35	3. 77	4. 66	6. 01
	3 Returns	8. 76	8. 90	8. 90	9. 05	9. 04	9. 21	9. 18	9. 38	9. 33	9. 55	9. 49	9. 73	9. 65	9. 91			
300	Sag	3. 00	3. 10	3. 09	3. 20	3. 19	3. 32	3. 30	3. 44	3. 41	3. 57	3. 52	3. 70	3. 64	3. 84	4. 33	5. 35	6. 90
	3 Returns	9. 39	9. 54	9. 53	9. 70	9. 68	9. 87	9. 84	10. 05	10. 00	10. 23	10. 17	10. 42	10. 34	10. 62			
CONDUCTOR		TENSION (kN)																
3/2. 00 SC/GZ		2. 72	2. 63	2. 64	2. 55	2. 56	2. 46	2. 48	2. 38	2. 40	2. 29	2. 32	2. 21	2. 24	2. 13	1. 89	1. 54	
3/2. 75 SC/GZ		5. 15	4. 99	5. 00	4. 83	4. 85	4. 66	4. 69	4. 50	4. 54	4. 34	4. 39	4. 18	4. 25	4. 02	3. 57	2. 89	
7/3. 25 SC/GZ		16. 34	16. 26	15. 84	15. 74	15. 35	15. 21	14. 86	14. 70	14. 38	14. 18	13. 90	13. 68	13. 43	13. 18	11. 73	9. 55	
7/3. 75 SC/GZ		20. 61	20. 54	19. 96	19. 85	19. 32	19. 17	18. 69	18. 50	18. 06	17. 84	17. 45	17. 19	16. 84	16. 55	14. 71	11. 99	

Refer NOTES Clause 8.2 Sheet 2

Creep Allowance @ 25ºC:6ºC

8.3 Sheet 90 STEEL RURAL (22. 5% UTS) 200m RULING SPAN

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
80	Sag	0. 21	0. 22	0. 21	0. 23	0. 22	0. 23	0. 23	0. 24	0. 23	0. 25	0. 24	0. 26	0. 25	0. 27	0. 30	0. 35	0. 45
	3 Returns	2. 48	2. 54	2. 51	2. 58	2. 55	2. 62	2. 59	2. 66	2. 62	2. 71	2. 67	2. 75	2. 71	2. 80			
100	Sag	0. 33	0. 34	0. 34	0. 35	0. 35	0. 37	0. 36	0. 38	0. 37	0. 39	0. 38	0. 40	0. 39	0. 42	0. 46	0. 55	0. 70
	3 Returns	3. 10	3. 17	3. 14	3. 22	3. 19	3. 28	3. 23	3. 33	3. 28	3. 39	3. 33	3. 44	3. 38	3. 50			
120	Sag	0. 47	0. 49	0. 48	0. 51	0. 50	0. 53	0. 51	0. 54	0. 53	0. 56	0. 55	0. 58	0. 56	0. 60	0. 67	0. 80	1. 00
	3 Returns	3. 72	3. 81	3. 77	3. 87	3. 82	3. 93	3. 88	4. 00	3. 94	4. 06	4. 00	4. 13	4. 06	4. 20			
140	Sag	0. 64	0. 67	0. 66	0. 69	0. 68	0. 72	0. 70	0. 74	0. 72	0. 77	0. 74	0. 79	0. 77	0. 82	0. 91	1. 09	1. 36
	3 Returns	4. 34	4. 44	4. 40	4. 51	4. 46	4. 59	4. 53	4. 66	4. 60	4. 74	4. 67	4. 82	4. 74	4. 91			
160	Sag	0. 84	0. 88	0. 86	0. 91	0. 89	0. 94	0. 91	0. 97	0. 94	1. 00	0. 97	1. 04	1. 00	1. 07	1. 19	1. 42	1. 78
	3 Returns	4. 96	5. 08	5. 03	5. 16	5. 10	5. 24	5. 18	5. 33	5. 25	5. 42	5. 34	5. 51	5. 42	5. 61			
180	Sag	1. 06	1. 11	1. 09	1. 15	1. 12	1. 19	1. 16	1. 23	1. 19	1. 27	1. 23	1. 31	1. 27	1. 36	1. 51	1. 80	2. 25
	3 Returns	5. 58	5. 71	5. 66	5. 81	5. 74	5. 90	5. 82	6. 00	5. 91	6. 10	6. 00	6. 20	6. 10	6. 31			
200	Sag	1. 31	1. 38	1. 35	1. 42	1. 39	1. 47	1. 43	1. 52	1. 47	1. 57	1. 52	1. 62	1. 57	1. 68	1. 86	2. 23	2. 78
	3 Returns	6. 21	6. 36	6. 29	6. 46	6. 39	6. 57	6. 48	6. 67	6. 58	6. 79	6. 68	6. 90	6. 78	7. 02			
220	Sag	1. 59	1. 67	1. 63	1. 72	1. 68	1. 78	1. 73	1. 84	1. 78	1. 90	1. 84	1. 96	1. 90	2. 03	2. 26	2. 69	3. 37
	3 Returns	6. 83	6. 99	6. 92	7. 11	7. 02	7. 22	7. 13	7. 34	7. 24	7. 46	7. 35	7. 59	7. 46	7. 72			
240	Sag	1. 89	1. 98	1. 94	2. 05	2. 00	2. 11	2. 06	2. 18	2. 12	2. 26	2. 19	2. 34	2. 26	2. 42	2. 69	3. 21	4. 01
	3 Returns	7. 45	7. 63	7. 55	7. 75	7. 66	7. 88	7. 78	8. 01	7. 89	8. 14	8. 02	8. 28	8. 14	8. 42			
260	Sag	2. 22	2. 33	2. 28	2. 40	2. 35	2. 48	2. 42	2. 56	2. 49	2. 65	2. 57	2. 74	2. 65	2. 84	3. 15	3. 76	4. 70
	3 Returns	8. 07	8. 27	8. 18	8. 40	8. 30	8. 53	8. 42	8. 68	8. 55	8. 82	8. 68	8. 97	8. 82	9. 13			
280	Sag	2. 57	2. 70	2. 64	2. 79	2. 72	2. 88	2. 80	2. 97	2. 89	3. 07	2. 98	3. 18	3. 07	3. 29	3. 65	4. 36	5. 46
	3 Returns	8. 69	8. 90	8. 81	9. 04	8. 94	9. 19	9. 07	9. 34	9. 21	9. 50	9. 35	9. 66	9. 50	9. 83			
300	Sag	2. 95	3. 10	3. 04	3. 20	3. 12	3. 30	3. 22	3. 41	3. 32	3. 53	3. 42	3. 65	3. 53	3. 78	4. 19	5. 01	6. 26
	3 Returns	9. 31	9. 54	9. 44	9. 69	9. 58	9. 85	9. 72	10. 01	9. 87	10. 18	10. 02	10. 35	10. 17	10. 53			
CONDUCTOR		TENSION (kN)																
3/2. 00 SC/GZ		2. 77	2. 63	2. 69	2. 55	2. 62	2. 47	2. 54	2. 39	2. 46	2. 32	2. 39	2. 24	2. 32	2. 17	1. 95	1. 64	
3/2. 75 SC/GZ		5. 24	4. 99	5. 10	4. 84	4. 95	4. 68	4. 81	4. 53	4. 66	4. 38	4. 52	4. 24	4. 39	4. 10	3. 68	3. 08	
7/3. 25 SC/GZ		16. 40	16. 26	15. 93	15. 77	15. 47	15. 28	15. 01	14. 80	14. 56	14. 32	14. 11	13. 86	13. 68	13. 41	12. 10	10. 17	
7/3. 75 SC/GZ		20. 68	20. 53	20. 07	19. 90	19. 48	19. 27	18. 89	18. 66	18. 32	18. 06	17. 76	17. 47	17. 21	16. 90	15. 26	12. 89	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC:10ºC

8.3 Sheet 91 **STEEL** **RURAL (22. 5% UTS)** **250m RULING SPAN**

SPAN LENGTH (m)	ELEMENT	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																BLOWOUT (m)
		Temperature																
		5ºC		10ºC		15ºC		20ºC		25ºC		30ºC		35ºC		50ºC	75ºC	
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
80	Sag	0. 21	0. 22	0. 21	0. 23	0. 22	0. 23	0. 22	0. 24	0. 23	0. 25	0. 23	0. 25	0. 24	0. 26	0. 29	0. 33	0. 41
	3 Returns	2. 45	2. 54	2. 49	2. 57	2. 52	2. 61	2. 55	2. 65	2. 59	2. 69	2. 63	2. 73	2. 66	2. 78			
100	Sag	0. 32	0. 34	0. 33	0. 35	0. 34	0. 36	0. 35	0. 37	0. 36	0. 39	0. 37	0. 40	0. 38	0. 41	0. 45	0. 52	0. 64
	3 Returns	3. 07	3. 17	3. 11	3. 22	3. 15	3. 27	3. 19	3. 32	3. 24	3. 37	3. 28	3. 42	3. 33	3. 47			
120	Sag	0. 46	0. 49	0. 47	0. 51	0. 49	0. 52	0. 50	0. 54	0. 51	0. 56	0. 53	0. 57	0. 54	0. 59	0. 65	0. 75	0. 92
	3 Returns	3. 68	3. 81	3. 73	3. 86	3. 78	3. 92	3. 83	3. 98	3. 89	4. 04	3. 94	4. 10	4. 00	4. 17			
140	Sag	0. 63	0. 67	0. 65	0. 69	0. 66	0. 71	0. 68	0. 74	0. 70	0. 76	0. 72	0. 78	0. 74	0. 81	0. 88	1. 03	1. 26
	3 Returns	4. 30	4. 44	4. 35	4. 51	4. 41	4. 58	4. 47	4. 65	4. 54	4. 72	4. 60	4. 79	4. 66	4. 86			
160	Sag	0. 82	0. 88	0. 84	0. 90	0. 87	0. 93	0. 89	0. 96	0. 92	0. 99	0. 94	1. 02	0. 97	1. 05	1. 15	1. 34	1. 64
	3 Returns	4. 91	5. 08	4. 98	5. 15	5. 04	5. 23	5. 11	5. 31	5. 18	5. 39	5. 26	5. 47	5. 33	5. 56			
180	Sag	1. 04	1. 11	1. 07	1. 15	1. 10	1. 18	1. 13	1. 22	1. 16	1. 25	1. 19	1. 29	1. 23	1. 33	1. 46	1. 70	2. 08
	3 Returns	5. 53	5. 71	5. 60	5. 80	5. 68	5. 89	5. 75	5. 97	5. 83	6. 07	5. 91	6. 16	6. 00	6. 25			
200	Sag	1. 29	1. 38	1. 32	1. 42	1. 36	1. 46	1. 40	1. 51	1. 44	1. 55	1. 48	1. 60	1. 52	1. 65	1. 81	2. 10	2. 56
	3 Returns	6. 15	6. 36	6. 23	6. 45	6. 32	6. 55	6. 40	6. 65	6. 49	6. 75	6. 58	6. 85	6. 67	6. 96			
220	Sag	1. 56	1. 67	1. 60	1. 72	1. 64	1. 77	1. 69	1. 82	1. 74	1. 88	1. 79	1. 94	1. 84	2. 00	2. 19	2. 54	3. 10
	3 Returns	6. 77	7. 00	6. 86	7. 10	6. 95	7. 20	7. 04	7. 31	7. 14	7. 42	7. 24	7. 54	7. 34	7. 65			
240	Sag	1. 86	1. 98	1. 90	2. 04	1. 96	2. 10	2. 01	2. 17	2. 07	2. 23	2. 12	2. 30	2. 18	2. 37	2. 60	3. 03	3. 69
	3 Returns	7. 38	7. 63	7. 48	7. 74	7. 58	7. 86	7. 68	7. 98	7. 79	8. 10	7. 90	8. 22	8. 01	8. 35			
260	Sag	2. 18	2. 33	2. 24	2. 40	2. 30	2. 47	2. 36	2. 54	2. 42	2. 62	2. 49	2. 70	2. 56	2. 79	3. 05	3. 55	4. 33
	3 Returns	7. 99	8. 27	8. 10	8. 39	8. 21	8. 51	8. 32	8. 64	8. 44	8. 77	8. 55	8. 91	8. 67	9. 04			
280	Sag	2. 53	2. 70	2. 59	2. 78	2. 66	2. 86	2. 74	2. 95	2. 81	3. 04	2. 89	3. 13	2. 97	3. 23	3. 54	4. 12	5. 02
	3 Returns	8. 61	8. 90	8. 72	9. 03	8. 84	9. 17	8. 96	9. 31	9. 09	9. 45	9. 21	9. 59	9. 34	9. 74			
300	Sag	2. 90	3. 10	2. 98	3. 19	3. 06	3. 29	3. 14	3. 39	3. 23	3. 49	3. 32	3. 60	3. 41	3. 71	4. 07	4. 73	5. 77
	3 Returns	9. 22	9. 54	9. 35	9. 68	9. 47	9. 82	9. 60	9. 97	9. 73	10. 12	9. 87	10. 28	10. 01	10. 43			
CONDUCTOR		TENSION (kN)																
3/2. 00 SC/GZ		2. 82	2. 63	2. 75	2. 56	2. 68	2. 48	2. 61	2. 41	2. 54	2. 34	2. 47	2. 27	2. 40	2. 21	2. 01	1. 73	
3/2. 75 SC/GZ		5. 34	4. 99	5. 20	4. 85	5. 06	4. 71	4. 93	4. 57	4. 79	4. 43	4. 66	4. 30	4. 53	4. 17	3. 80	3. 27	
7/3. 25 SC/GZ		16. 45	16. 26	16. 01	15. 80	15. 58	15. 35	15. 16	14. 91	14. 74	14. 47	14. 33	14. 05	13. 93	13. 64	12. 46	10. 75	
7/3. 75 SC/GZ		20. 72	20. 53	20. 17	19. 95	19. 62	19. 38	19. 09	18. 82	18. 57	18. 28	18. 06	17. 76	17. 56	17. 24	15. 79	13. 71	

Refer NOTES Clause 8.2 Sheet 2 Creep Allowance @ 25ºC:13ºC

Services – Single Span

8.3 Sheet 92 SERVICES SLACK (2% UTS) SINGLE SPAN

CONDUCTOR		MINIMUM SAG (m) @ 25ºC																TENSION (kN)
		SPAN LENGTH (m)																
		5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	
Al/XLPE	2C 25mm2	0. 08	0. 22	0. 44	0. 75	1. 14	1. 63	2. 20	2. 87	3. 62	4. 47	5. 41	6. 44	7. 57	8. 80	10. 12	11. 55	0. 14
	3C 25mm2																	0. 21
	4C 25mm2																	0. 28
	4C 95mm2																	0. 92
	2 x 4C 95mm2																	1. 84
Cu/PVC See Note 5	2C 16mm2																	0. 24
	3C 16mm^2																	0. 36
	4C 16mm^2																	0. 47

Notes:

1. Creep may be ignored for slack-strung service conductors.
2. Allow 0. 25m additional clearance to allow for increased sag under maximum temperature conditions.
3. Reference temperature for conductor stringing (% UTS) is 5ºC. Tension is for ‘no wind’ condition at 5ºC.
4. Blow-out may be taken to be the same as the sag.
5. For all new services, use Aluminium/XLPE types service types. Information is provided for obsolete service types for situations involving work on the

8.4 Worked examples

EXAMPLE 1 – Single urban span

A new span of MERCURY (7/4.50 AAC) 11kV mains is to be erected between two poles spaced 52m apart, with a termination at each and.

Determine a suitable stringing tension and the resulting final sag when the conductor is at its maximum design temperature of 75°C. Also, determine the mid-span blowout.

After referring at the table in Clause 8.1, we select 6% UTS as a suitable stringing tension for a 52m span. It is well within the 30m-90m span range for this tension.

As the span is terminated at each end, the Ruling Span (RS) for the ‘strain section’ is the length of the single span itself, 52m.

We now have to select a suitable stringing table and turn to the index sheet 8.2.1. We select sheet 8.3. Sheet 4 for AAC, 6% UTS, and RS of 60m, which is the closest available value to 52m.

		AAC 6%UTS 60m RS								SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)								
		Temperature																
SPAN LENGTH (m)	ELEMENT	5°C		10°C		15°C		20°C		25°C		30°C		35°C		50°C	75°C	BLOWOUT (m)
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
30	Sag	0.32	**0.33**	0.33	**0.34**	0.34	**0.36**	0.36	**0.37**	0.37	**0.38**	0.38	**0.39**	0.39	**0.40**	**0.44**	**0.49**	0.40
	3 Returns	3.04	**3.11**	3.11	**3.18**	3.17	**3.23**	3.23	**3.29**	3.29	**3.35**	3.34	**3.40**	3.39	**3.45**			
40	Sag	0.56	**0.59**	0.59	**0.61**	0.61	**0.64**	0.63	**0.66**	0.66	**0.68**	0.68	**0.70**	0.70	**0.72**	**0.78**	**0.87**	0.71
	3 Returns	4.06	**4.16**	4.15	**4.24**	4.23	**4.32**	4.31	**4.39**	4.39	**4.47**	4.46	**4.54**	4.53	**4.60**			
50	Sag	0.88	**0.92**	0.92	**0.96**	0.96	**0.99**	0.99	**1.03**	1.03	**1.06**	1.06	**1.10**	1.09	**1.13**	**1.22**	**1.36**	1.11
	3 Returns	5.08	**5.20**	5.19	**5.30**	5.30	**5.40**	5.39	**5.50**	5.49	**5.59**	5.58	**5.67**	5.66	**5.76**			
60	Sag	1.27	**1.33**	1.32	**1.38**	1.38	**1.43**	1.43	**1.48**	1.48	**1.53**	1.53	**1.58**	1.58	**1.63**	**1.76**	**1.96**	1.59
	3 Returns	6.10	**6.24**	6.23	**6.37**	6.36	**6.49**	6.48	**6.60**	6.59	**6.71**	6.70	**6.81**	6.80	**6.91**			

Turning to sheet 8.3. Sheet 4, we locate the row for a 50m span and the column for 75°C final sag. We notice that the sag value is 1.36m. Looking at the row below, for a 60m span, we note that sag is 1.96m. We need to interpolate between these two values for our 52m span, which lies approximately 2/10 of the way between 50m and 60m, as follows:

75°C Final Sag = 1.36 + ((2/10 * (1.96 – 1.36)) = 1.36 + 0.2 * 0.60 = **1.48m**

Similarly, we can interpolate between the two values of 1.11m and 1.59m for blowout:

Blowout = 1.11 + ((2/10 * (1.59 – 1.11)) = **1.21m**

These values may be sufficiently accurate for our purposes. However, if we wish to be more precise, we can also consult sheet 8.3. Sheet 3, which is for a RS of 40m. From this table and again interpolating between the 50m and 60m rows, we obtain a sag value of 1.94m and a blowout value of 1.45m. These results are higher than for the 60m RS. We can interpolate between these two tables, recognizing that the 52m RS value lies approximately 8/20 of the way between 60m and 40m RS values, as follows:

75°C Final Sag = 1.49 + ((8/20 * (1.94 – 1.49)) = 1.67m

Blowout = 1.21 + ((8/20 * (1.45 – 1.21)) = 1.31m

EXAMPLE 2 – Short rural extension

A three span rural 11kV extension using APPLE (6/1/3.00 ACSR) conductor is proposed. The pole positions are aligned with lot boundaries, with span lengths of 140m, 150m and 200m. The ground is reasonably flat.

Determine a suitable stringing tension. Also, assuming that the conductor attachment points are 11.5m high, what will be the worst case ground clearance for the line?

After referring at the table in Clause 8.1, we select 22.5% UTS as a suitable stringing tension, with all three spans lying within the 100m – 260m span range for this tension. Although the spans vary somewhat, the variation is not sufficiently great to warrant splitting the line into more than one strain section.

The Ruling Span for the line can be calculated as follows:

$$RS = \sqrt{\left[\frac{(140^3 + 150^3 + 200^3)}{(140 + 150 + 200)} \right]} = 170\text{m}$$

We now turn to the stringing table index sheet 8.2.1 and select table 8.3. Sheet 40, which is for a RS of 150m, which is the closest value to 170m available

ACSR 6/1 22.5%UTS 150m RS		SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)																
		Temperature																
SPAN LENGTH (m)	ELEMENT	5°C		10°C		15°C		20°C		25°C		30°C		35°C		50°C	75°C	BLOWOUT (m)
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FINAL	FINAL	
80	Sag	0.30	**0.40**	0.32	**0.43**	0.34	**0.46**	0.35	**0.49**	0.37	**0.53**	0.39	**0.56**	0.42	**0.59**	**0.70**	**0.81**	0.83
	3 Returns	2.99	**3.42**	3.06	**3.55**	3.14	**3.67**	3.22	**3.80**	3.31	**3.93**	3.40	**4.05**	3.50	**4.17**			
100	Sag	0.48	**0.62**	0.50	**0.67**	0.52	**0.72**	0.55	**0.77**	0.58	**0.82**	0.62	**0.87**	0.65	**0.93**	**1.09**	**1.27**	1.30
	3 Returns	3.74	**4.28**	3.83	**4.43**	3.92	**4.59**	4.03	**4.75**	4.14	**4.91**	4.26	**5.07**	4.38	**5.22**			
120	Sag	0.68	**0.90**	0.72	**0.97**	0.76	**1.03**	0.80	**1.11**	0.84	**1.18**	0.89	**1.26**	0.94	**1.34**	**1.57**	**1.83**	1.87
	3 Returns	4.48	**5.14**	4.59	**5.32**	4.71	**5.51**	4.84	**5.70**	4.97	**5.89**	5.11	**6.08**	5.26	**6.27**			
140	Sag	0.93	**1.22**	0.98	**1.31**	1.03	**1.41**	1.08	**1.51**	1.14	**1.61**	1.21	**1.72**	1.28	**1.82**	**2.14**	**2.49**	2.54
	3 Returns	5.23	**6.00**	5.36	**6.21**	5.50	**6.43**	5.64	**6.65**	5.80	**6.88**	5.96	**7.10**	6.13	**7.31**			
160	Sag	1.22	**1.60**	1.28	**1.72**	1.34	**1.84**	1.42	**1.97**	1.49	**2.10**	1.58	**2.24**	1.67	**2.38**	**2.79**	**3.25**	3.32
	3 Returns	5.98	**6.85**	6.12	**7.10**	6.28	**7.35**	6.45	**7.60**	6.62	**7.86**	6.81	**8.11**	7.00	**8.35**			
180	Sag	1.54	**2.03**	1.62	**2.17**	1.70	**2.33**	1.79	**2.49**	1.89	**2.66**	2.00	**2.84**	2.12	**3.01**	**3.54**	**4.12**	4.21
	3 Returns	6.73	**7.71**	6.89	**7.99**	7.07	**8.27**	7.26	**8.56**	7.46	**8.84**	7.67	**9.13**	7.89	**9.40**			
200	Sag	1.91	**2.51**	2.00	**2.69**	2.11	**2.89**	2.22	**3.09**	2.35	**3.30**	2.48	**3.51**	2.62	**3.73**	**4.39**	**5.11**	5.19
	3 Returns	7.49	**8.58**	7.67	**8.89**	7.87	**9.20**	8.08	**9.52**	8.30	**9.84**	8.53	**10.16**	8.78	**10.47**			
220	Sag	2.31	**3.03**	2.42	**3.26**	2.55	**3.49**	2.68	**3.74**	2.83	**3.99**	3.00	**4.25**	3.17	**4.51**	**5.30**	**6.17**	6.29

We locate the row for a 200m span (the longest span with the greatest sag) and the column for 75°C final sag (the maximum conductor design temperature) and read the sag value of **5.11m**.

(This value is sufficiently accurate for our purposes. However, if we wished to be more precise, we could also consult sheet 8.3. Sheet 41, which is for a RS of 200m. This table gives a sag value of 4.45m, and then interpolate between 5.11 and 4.45 to obtain a value of 4.85.)

Given 11.5m attachment heights on the poles, the worst case ground clearance will then be:

11.5 – 5.11 = 6.39m.

EXAMPLE 3 – Determine tension in existing mains

The sag in an existing 40m span of 7/2.75 Copper LV mains is measured at 1.20m. The ambient air temperature is 30°C. The day is sunny and there is a moderate breeze. Determine a suitable stringing tension.

We need to guess what stringing tension has been used, and see how the sag values for the stringing table compare with actual sag.

Given that the conductor will be secured at each end of the span, either by a termination or being tied off on a pin insulator, we will take the RS to be equal to the span length.

Let us assume that the conductor temp. is 5°C above ambient, i.e. 35°C.

After referring at the table in Clause 8.1, we would expect the tension to be of the order of 6% UTS for a span of 40m. Turning to the sheet index 8.2.1, we see that for HDC 6% 40m RS we need to consult sheet 8.3.72.

		HDC 6%UTS 40m RS	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)													
SPAN LENGTH (m)	ELEMENT	Temperature														
		5°C		10°C		15°C		20°C		25°C		30°C		35°C		50°C
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FIN
30	Sag	0.40	**0.41**	0.42	**0.43**	0.44	**0.44**	0.45	**0.46**	0.47	**0.48**	0.48	**0.49**	0.50	**0.51**	[illegible]
	3 Returns	3.44	**3.47**	3.52	**3.55**	3.58	**3.61**	3.65	**3.68**	3.71	**3.74**	3.77	**3.80**	3.83	[illegible]	
40	Sag	0.72	**0.73**	0.75	**0.76**	0.78	**0.79**	0.81	**0.82**	0.84	**0.85**	0.86	**0.88**	0.89	$\boxed{0.90}$	[illegible]
	3 Returns	4.60	**4.64**	4.69	**4.73**	4.78	**4.82**	4.87	**4.91**	4.95	**4.99**	5.03	**5.07**	5.11	[illegible]	
50	Sag	1.13	**1.15**	1.17	**1.20**	1.22	**1.24**	1.27	**1.29**	1.31	**1.33**	1.35	**1.37**	1.39	**1.42**	[illegible]

Looking at the row for a 40m span and 35°C final sag (as the conductor has been in-service for some time), we obtain a sag value of 0.90m. This is a little less than the measured value of 1.20m, so obviously the stringing tension is less than 6% UTS.

		HDC 2%UTS 40m RS	SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)													
SPAN LENGTH (m)	ELEMENT	Temperature														
		5°C		10°C		15°C		20°C		25°C		30°C		35°C		50°C
		INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	FIN
20	Sag	0.55	**0.55**	0.55	**0.55**	0.56	**0.55**	0.56	**0.56**	0.56	**0.56**	0.56	**0.56**	0.56	**0.56**	[illegible]
	3 Returns	4.02	**4.02**	4.03	**4.03**	4.04	**4.03**	4.04	**4.04**	4.05	**4.05**	4.05	**4.06**	4.06	**4.06**	
25	Sag	0.89	**0.89**	0.89	**0.89**	0.89	**0.89**	0.90	**0.89**	0.90	**0.90**	0.90	**0.90**	0.90	**0.90**	[illegible]
	3 Returns	5.10	**5.09**	5.11	**5.10**	5.11	**5.11**	5.12	**5.12**	5.13	**5.13**	5.14	**5.13**	5.15	**5.14**	
30	Sag	1.25	**1.25**	1.26	**1.26**	1.27	**1.27**	1.27	**1.27**	1.28	**1.28**	1.29	**1.28**	1.29	**1.29**	[illegible]
	3 Returns	6.06	**6.06**	6.08	**6.07**	6.09	**6.09**	6.11	**6.10**	6.12	**6.12**	6.14	**6.13**	6.15	**6.15**	
35	Sag	1.71	**1.7**	1.72	**1.71**	1.72	**1.72**	1.73	**1.73**	1.74	**1.74**	1.75	**1.75**	1.76	**1.76**	[illegible]
	3 Returns	7.07	**7.06**	7.08	**7.08**	7.10	**7.10**	7.12	**7.12**	7.14	**7.13**	7.16	**7.15**	7.18	[illegible]	
40	Sag	2.23	**2.23**	2.24	**2.24**	2.25	**2.25**	2.26	**2.26**	2.28	**2.28**	2.29	**2.29**	2.30	$\boxed{2.30}$	[illegible]
	3 Returns	8.07	**8.07**	8.09	**8.09**	8.11	**8.13**	8.13	**8.16**	8.16	**8.18**	8.18	**8.20**	8.20	[illegible]	

Trying out the table for 2% UTS, sheet 8.3.71, we get a sag value of 2.30m, which is considerably larger than the measured value of 1.20m. So obviously the tension lies between 2% and 6% UTS.

Now, we notice that the actual sag is approximately half the sag expected for 2% UTS. Now, halving the sag is equivalent to doubling the tension, so we will take the stringing tension to be 4% UTS.

EXAMPLE 4 – Determine sag in spans down steep incline

Two spans of 22kV mains are to be run down the side of a steep mountain, teeing off an existing line along the crest of the range. The middle pole is to be an intermediate delta pin configuration. The conductor to be used is CHERRY (6/4.75 Al. + 7/1.60 Steel) strung using the RURAL 22.5% UTS table. The first span covers a horizontal distance of 150m and vertical distance of 50m. The second span covers a horizontal distance of 180m and a vertical distance of 40m. Determine the sag in each span when the conductor is at 75°C.

We need to determine the RS for the strain section. Firstly, we calculate the inclined span lengths:

$$l_1 = \sqrt{(L_1^2 + h_1^2)} = \sqrt{(150^2 + 50^2)} = 158.1\text{m}$$

$$l_2 = \sqrt{(L_2^2 + h_2^2)} = \sqrt{(180^2 + 40^2)} = 184.4\text{m}$$

For steep slopes we use the following formula for RS:

$$RS = \sqrt{\left[\frac{(150^4 + 180^4)}{(158.1^2 + 184.4^2)} \right]} = 162 \text{ m}$$

We now turn to the stringing table index sheet 8.2. Sheet 1 and select table 8.3. Sheet 40, which is for 6/1 ACSR with a RS of 150m, which is the closest value to 162m available.

ACSR 6/1 22.5%UTS 150m RS — SAG (m) / TIME FOR 3 TRAVELLING WAVE RETURNS (s)

SPAN LENGTH (m)	ELEMENT	5°C INITIAL	5°C FINAL	10°C INITIAL	10°C FINAL	15°C INITIAL	15°C FINAL	20°C INITIAL	20°C FINAL	25°C INITIAL	25°C FINAL	30°C INITIAL	30°C FINAL	35°C INITIAL	35°C FINAL	50°C FINAL	75°C FINAL	BLOWOUT (m)
80	Sag	0.30	**0.40**	0.32	**0.43**	0.34	**0.46**	0.35	**0.49**	0.37	**0.53**	0.39	**0.56**	0.42	**0.59**	**0.70**	**0.81**	0.83
	3 Returns	2.99	**3.42**	3.06	**3.55**	3.14	**3.67**	3.22	**3.80**	3.31	**3.93**	3.40	**4.05**	3.50	**4.17**			
100	Sag	0.48	**0.62**	0.50	**0.67**	0.52	**0.72**	0.55	**0.77**	0.58	**0.82**	0.62	**0.87**	0.65	**0.93**	**1.09**	**1.27**	1.30
	3 Returns	3.74	**4.28**	3.83	**4.43**	3.92	**4.59**	4.03	**4.75**	4.14	**4.91**	4.26	**5.07**	4.38	**5.22**			
120	Sag	0.68	**0.90**	0.72	**0.97**	0.76	**1.03**	0.80	**1.11**	0.84	**1.18**	0.89	**1.26**	0.94	**1.34**	**1.57**	**1.83**	1.87
	3 Returns	4.48	**5.14**	4.59	**5.32**	4.71	**5.51**	4.84	**5.70**	4.97	**5.89**	5.11	**6.08**	5.26	**6.27**			
140	Sag	0.93	**1.22**	0.98	**1.31**	1.03	**1.41**	1.08	**1.51**	1.14	**1.61**	1.21	**1.72**	1.28	**1.82**	**2.14**	**2.49**	2.54
	3 Returns	5.23	**6.00**	5.36	**6.21**	5.50	**6.43**	5.64	**6.65**	5.80	**6.88**	5.96	**7.10**	6.13	**7.31**			
160	Sag	1.22	**1.60**	1.28	**1.72**	1.34	**1.84**	1.42	**1.97**	1.49	**2.10**	1.58	**2.24**	1.67	**2.38**	**2.79**	**3.25**	3.32
	3 Returns	5.98	**6.85**	6.12	**7.10**	6.28	**7.35**	6.45	**7.60**	6.62	**7.86**	6.81	**8.11**	7.00	**8.35**			
180	Sag	1.54	**2.03**	1.62	**2.17**	1.70	**2.33**	1.79	**2.49**	1.89	**2.66**	2.00	**2.84**	2.12	**3.01**	**3.54**	**4.12**	4.21
	3 Returns	6.73	**7.71**	6.89	**7.99**	7.07	**8.27**	7.26	**8.56**	7.46	**8.84**	7.67	**9.13**	7.89	**9.40**			
200	Sag	1.91	**2.51**	2.00	**2.69**	2.11	**2.89**	2.22	**3.09**	2.35	**3.30**	2.48	**3.51**	2.62	**3.73**	**4.39**	**5.11**	5.19
	3 Returns	7.49	**8.58**	7.67	**8.89**	7.87	**9.20**	8.08	**9.52**	8.30	**9.84**	8.53	**10.16**	8.78	**10.47**			
220	Sag	2.31	**3.03**	2.42	**3.26**	2.55	**3.49**	2.68	**3.74**	2.83	**3.99**	3.00	**4.25**	3.17	**4.51**	**5.30**	**6.17**	6.29

We locate the column for 75°C final sag. For the 180m span, we read a sag value of **4.12m**.

To get a value for a 150m span, we will need to average between the 140m row and the 160m row.

This gives us a value half way between 2.49m and 3.25m, i.e. **2.87m**.

8.5 Engineering notes

Stringing table ranges

As a general rule, users of stringing tables should avoid extrapolating beyond the range of span lengths provided. Within any strain section, designers should avoid having span lengths that are less than half or more than double the ruling span. (Outside this ratio Ruling Span Assumption fails at higher conductor operating temperature and can cause excessive sag in longest span in tension section).

In fact, on tight-strung lines, it is desirable that the longest span within a strain section not be more than double the length of the shortest span within the strain section.

'Very short' spans are span lengths below those span lengths listed in the Stringing Tables.

For very short spans that have to be slack-strung, **where there is no suitable stringing table available**, it is recommended that sag be set to 4% of span length.

It is recommended that a minimum stringing tension of 10%UTS be used for ACSR conductors with a high proportion of steel strands so that helical termination (dead-end) fittings remain adequately tensioned to maintain proper grip.

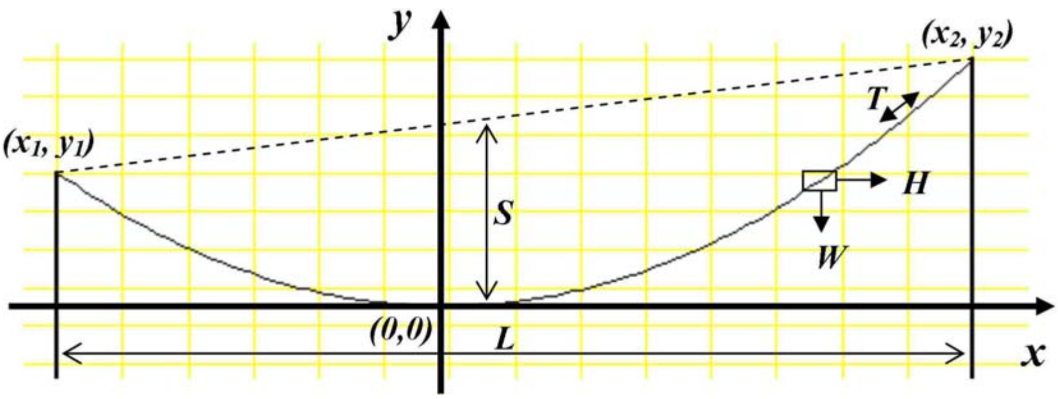
Stringing tension limits

It is recommended that designers do not nominate stringing tensions exceeding those used in the stringing tables provided within this section, except where carried out strictly in accordance with Reference 23 Annexure Z. Tight stringing usually requires conductor armour rods/grips at supports, vibration damping and suitable clamping arrangements.

Conductors can suffer fatigue, wire fracture, conductor elongation and/or failure if excessive static and dynamic stresses are applied. This can result from excessive mechanical loading including tension, bending and compressive stresses, vibration amplitude and frequency. It is important that adequate margin be allowed for construction stresses and the increase in tensions in short spans during extreme cold weather.

Catenary curve

The sag in a flexible conductor suspended from two structures depends upon span length, the stringing tension, conductor weight, the elasticity of the conductor material and the temperature.



The conductor assumes a shape similar to that shown above. The curve is given by the equation:

$$y = C\,(\cosh(x/C) - 1)$$

where:

x	horizontal distance from lowest point in span (m)
y	vertical distance from lowest point of span (m)
C	catenary constant

Under no-wind conditions, the catenary constant is essentially the ratio of the horizontal tension in the conductor to the unit weight:

$C = H / W$

where:

H horizontal component of tension in conductor (N)
W distributed load on conductor (N/m)

and

$W = m\, g$

where:

m unit mass of conductor (kg/m)
g gravitational acceleration of 9. 81 m/s^2

However, for distribution lines where the sag, *S*, is generally less than 10% of the span length *L*, the shape may be closely approximated by a parabola. Thus the equation for the catenary curve may be simplified as follows:

$$y = x^2 / 2C$$

Also:

$$C = L^2 / 8\, S$$

In practical terms, this means that close to the supports the conductor falls away sharply, but is fairly flat in its midsection. At a point 25% of the way along the span, the sag is 75% of its maximum value.

True conductor length

The true conductor length, L_C, is only marginally greater than the span length, *L*. The true conductor length from the span low point to a given point along the conductor, S, is given by the following equation:

$$L_C = C \sinh (x / C)$$

For a level span, the distance from the low point to the end is x = L/2. Thus the total conductor length is:

$$L_C = 2\, C \sinh (L / 2C)$$

which can be approximated to:

$$L_C = L + L^3 / 24\, C^2$$

Thus the 'slack' in the line, i. e. the difference between actual conductor length and horizontal distance between structures, is given by the expression:

$$\text{Slack} = L^3 / 24\, C^2$$

or

$$\text{Slack} = 8S^2 / 3L$$

For example, consider a 100m span of PLUTO (19/3. 75 AAC) strung at 10%UTS, i. e. 3. 19kN. The sag will be 2. 22m. Using the equation above, we find that the slack is 131mm, i. e. the true conductor length is 100. 131m. A small change to the amount of slack makes a large difference to conductor sag.

Changes in conductor length

Now, the actual length of the conductor is affected by two factors:

- conductor elastic stretch under tension, and
- conductor expansion and contraction according to temperature.

As the length of the conductor changes, so too does the sag in the span.

Conductor elastic stretch is a function of:

- tension, *T*
- the modulus of elasticity of the conductor material (Young's modulus), *E*
- the cross-sectional area of the conductor, *A*.

The modulus of elasticity is the ratio of stress to strain, as follows:

$$E = \text{Stress} / \text{Strain}$$

i. e.

$$\text{Strain} = \text{Stress} / E$$

i. e.

$$(L_{Cf}-L_{Ci}) / L_{Ci} = T / EA$$

where:

L_{Cf} final length of conductor (m)
L_{Ci} initial length of conductor (m)
E Modulus of elasticity (Pa)
A Cross-sectional area of the conductor (m^2)

The change in length with temperature is governed by the coefficient of linear expansion, α, for the conductor material. For aluminium, this is only 23 x 10^{-6} per degree Celsius. Nonetheless it is surprising how much variation in sag this small change in conductor length produces.

$$L_{Cf}=L_{Ci}\,(1 + \alpha\,(t_f - t_i))$$

where:

t_f final temperature of conductor (ºC)
t_i initial temperature of conductor (ºC)
α coefficient of linear expansion (/ºC)

As temperature increases, the conductor expands in length and therefore its tension decreases, while the sag increases. With the reduction in tension, there is also a reduction in the strain (elastic stretch) in the conductor. Thus, there is a complicated relationship between temperature and tension. Conductor tension at a given operating temperature can be calculated by iteratively solving the following equation:

$$T^3 + T^2\left(\frac{(W_0 L)^2 AE}{24 T_0} - T_0 + t\alpha AE\right) + \frac{(W_0 L_R)^2 AE}{24} = 0$$

where:

T_0 = initial conductor tension at initial temperature (N)
W_0 = unit weight of conductor at initial temperature (N/m)
t = temperature change from initial (kg/m)
E = final modulus of elasticity (Pa)

A = cross-sectional area of conductor (m^2)
α = coefficient of linear expansion (/°C)
L_R = length of ruling span – simply span length *L* for a single span (m)

Basic sag-tension relationship

The basic relationship between sag and span length, for an isolated level span, is as follows:

$$S = C\left(\cosh\left(\frac{L}{2C}\right) - 1\right)$$

Where the sag is small compared with the span length, as in the majority of distribution lines, we may treat the catenary shape as parabolic. Conductor tension *T* is approximately equal to *H*, the horizontal component of the tension. The sag is then given by the simplified equation:

$$S = \frac{WL^2}{8T}$$

Conversely, the equation may be re-arranged to give tension as a function of sag:

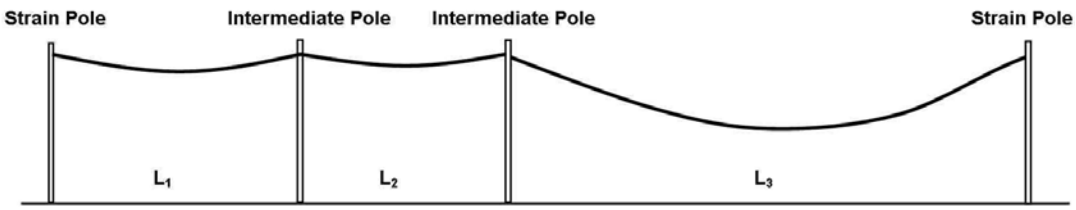
$$T = \frac{WL^2}{8S}$$

For a constant tension, sag varies with the square of span length. So, given a fixed stringing tension, for a <u>doubling</u> of span length there is a <u>quadrupling</u> of the sag.

While have described *W* in the above equation as the unit weight of the conductor, we could have called this 'uniformly distributed load'. In this way, apart from conductor weight, we could include any loading due to snow or ice. Similarly, we could use *W* to represent the horizontal force due to wind action (pressure x area) to determine 'horizontal sag' under blowout conditions.

Ruling span

Where a conductor is rigidly fixed at both ends of a span, the span behaves independently of any other spans in the line. However, where the conductor is free to move at its supports (such as when it is being strung on rollers, or where it is supported by suspension insulators which can swing to the side), the various spans within a strain section will interact if they differ significantly in length. The simple sag tension relationships will not apply - large spans will dominate.



The Ruling Span (RS) or Mean Equivalent Span is a theoretical span length which represents the behaviour of the spans within the strain section and can be used to determine the conductor tension, which will be identical in all spans within the strain section.

The significance of RS is particularly important in tight-strung lines where the span lengths in a strain section vary significantly. If no correction is made for RS, then sag calculations for the maximum conductor operating temperature may be very inaccurate and lead to clearance violations. Conversely, the effect of RS can be ignored for single level spans and where all the span lengths within a strain section are similar. **It is crucial that users of the stringing tables within this manual select the correct table, one having a RS similar to that of portion of line that they are considering**.

The general formula for ruling span is as follows:

$$L_R = \sqrt{\frac{L_1^3 + L_2^3 + L_3^3 + \ldots}{L_1 + L_2 + L_3 + \ldots}}$$

Due to taking the cube of the span lengths, this equation gives a RS that is higher than a simple arithmetic mean or average of the span lengths, reflecting the influence of large spans.

For very steep inclines, the formula can be modified as follows:

$$L_R = \sqrt{\frac{\frac{L_1^4}{l_1} + \frac{L_2^4}{l_2} + \frac{L_3^4}{l_3} + \ldots}{l_1 + l_2 + l_3 + \ldots}}$$

where: $l = \sqrt{L^2 + h^2}$

l = inclined span length (m)
h = vertical height difference between ends of span (N/m)

For a single inclined, this formula can be simplified to: $L_R = \frac{L^2}{l}$

Creep

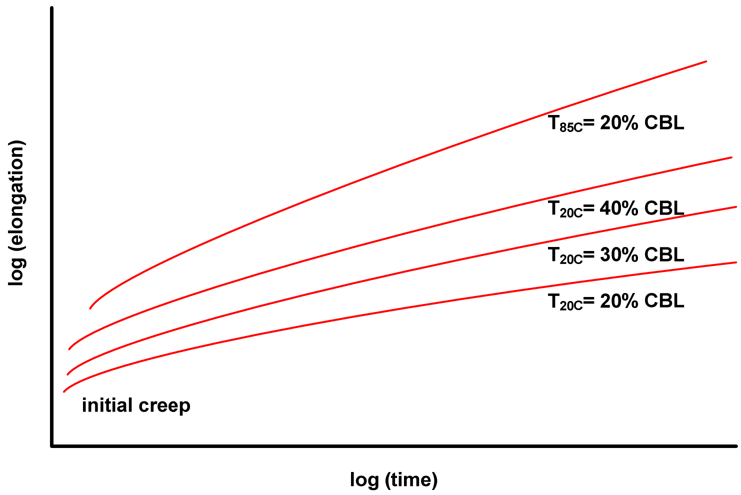
Most materials subjected to stress will suffer from creep, i. e. permanent elongation or inelastic stretch. The extent of the creep depends upon:

- the material - aluminium is more susceptible than copper or steel
- the manufacturing process - depends on whether hot rolled or extruded
- conductor tension - the tighter the line, the more significant the effect
- operating temperature - the higher the operating temperature, the more creep progresses
- time - creep becomes evident within hours of erecting a line and progresses steadily over many years
- stranding - there is a settling in of the strands
- ruling span.

Due to creep, the sag in a span of mains will increase following installation and may in time lead to insufficient clearances if not allowed for correctly.

Designers should allow for *final* sags when determining clearances, but ensure that construction crews install the line with lower *initial* sags, i. e. slightly over tensioned initially, knowing that the tension will fall off with time as creep occurs.

The effect of creep is often modelled simply by an equivalent change in temperature, i. e. the temperature change which produces the same change in conductor length. Below each stringing table within this manual an equivalent temperature correction for creep is stated. For tight-strung aluminium conductors, this correction can even exceed 25°C, whereas for very slack stringing the effect of creep is negligible.



The actual elongation of the conductor can be modelled as follows:

$$\varepsilon = \alpha t^{\beta} \sigma^{\gamma} e^{\delta(\theta - 20)}$$

where

ε = unit strain (mm. km^{-1} or µS)
t = time (years)
σ = average conductor stress (MPa)
θ = average conductor temperature (°C)
α, β, γ and δ are constants

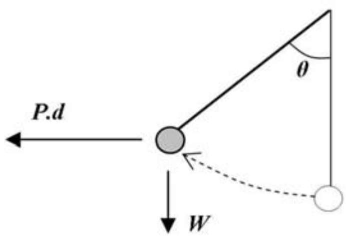
If the average temperature over the life of the conductor is assessed to be 20°C, the above equation may be reduced to:

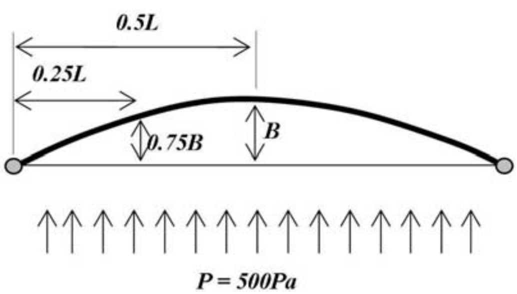
$$\varepsilon = \alpha t^{\beta} \sigma^{\gamma}$$

Conductor constants are determined by conductor creep tests as described in *AS 3822*.

Blowout

Blowout, or 'horizontal sag', is the displacement of the conductor horizontally under high wind conditions. As a general rule, blowout is of a similar magnitude to vertical sag within a span. Aluminium conductors, which have low weight but large diameter, are particularly susceptible to this and a blowout angle of 65° from the vertical is typical.





The blowout angle may be computed as follows:

$$\theta = \arctan\left(\frac{Pd}{W}\right)$$

where:

P = wind pressure (Pa)—taken to be 500Pa
d = conductor diameter (m)
W = unit weight of conductor (N/m) = 9. 81 x unit mass (kg/m)

To determine the blowout of the conductor at a point other than the midspan, the shape may be assumed to be parabolic. Thus, at points one quarter of the way from the ends of the span, the blowout will be 75% of that at the middle of the span. At points 10% of the way along span, blowout is 36% of that at midspan.

Communications cables

Communication cables are often strung to a fixed percentage of span length and clamped at every pole, making them independent of adjacent spans. Thus adjacent spans may differ in tension if of different lengths. For broadband communications cables erected by Telstra or Optus within Australia, typically sag is 2% of span length or a little less.

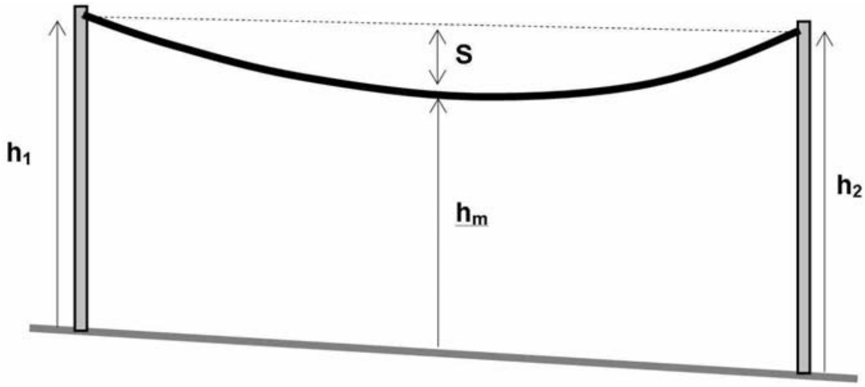
Reference can be made to Telstra and Optus Design Manuals, to Pole Joint Use Agreements, and Australian Standards for Telecommunications.

Determining sag in existing conductors

It is often necessary to measure sag in existing lines to determine the stringing tension that has been used.

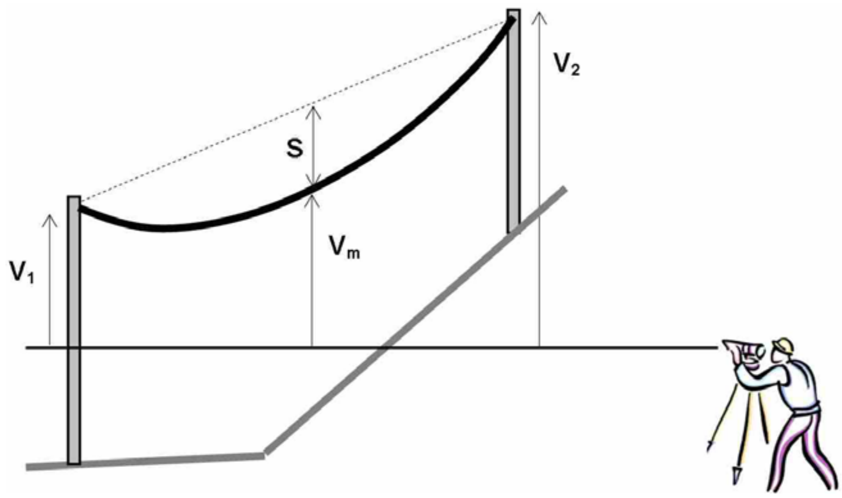
For many distribution situations, the approach illustrated below may be used. The sag is the difference between the average of the two end heights and the mid-span height.

$S = [(h_1 + h_2) / 2] - h_m$



Where the ground line slope varies and there is a dip or hump mid-span, vertical heights may be measured of the ends of the span and the midpoint relative to the position of an observer away from the span. This is also useful where it is impractical to measure conductor height from directly below the conductor, e. g. at a waterway crossing.

$S = [(V_1 + V_2) / 2] - V_m$



Safety Note: This technique requires a pre-work Risk assessment, and can only be used on Ausgrid Network energised conductors by Ausgrid Authorised Personnel Only.

It is another technique used for sag measurement called “wave timing”. This technique is more relevant to construction than design, as it relies on striking the conductor, which involves a measure of risk. This method relies on the relationship between tension and the speed of propagation of the pulse or wave along the conductor from where it is struck and its reflection from the far end. The time must be measured very precisely with a stopwatch. Common practice is to time from the strike to the third wave return. The sag in the span, *S*, may be computed according to the following equation for *N* wave returns:

$$S = \frac{9.81}{32}\left(\frac{t}{N}\right)^2$$

or for 3 wave returns:

$$S = 0.\ 0341\ t^2$$

where:

S	= Sag (m)
t	= time for N return waves (s)
N	= number of wave returns

9.0 POLES

9.1 Pole selection guidelines

Pole type

Ausgrid generally uses CCA-treated wood poles for distribution lines.

Pole length

Length	Typical Application
~~9. 5m~~	~~Cross-street service poles~~ (No future use permitted)
10m	Stay poles
11m	LV poles
12. 5m	11kV or 22kV poles
14m	Transformer, recloser, regulator or HV UGOH poles

Notes:

1. The table above is intended as a general guideline only and apply to typical situations. Designers need to choose pole length to suit the topography, number of circuits (initial or future), type of pole-top construction, street light mounting requirements, sinking depth etc.
2. While additional length may help achieve clearances from ground and between circuits, do not increase pole length beyond what is reasonably required. Longer poles are more expensive to source, transport and erect, and more susceptible to lightning strikes. Also, they may make access to and operation of pole-top plant more difficult.

Pole strength rating selection for new poles

Poles should be sized so that strength/capacity always exceeds applied mechanical load.

In general, heavier poles (8 or 12kN working strength) are used for terminations and line deviations, whereas lighter poles (6kN working strength) are used for intermediate in-line sites. (Note: 4kN poles are no longer used.)

For poles supporting heavy plant such as transformers, reclosers, or regulators refer to NS122 for details of pole of working strength.

Use of an un-stayed heavy pole is preferable to a light pole that is stayed. Where a stay cannot be avoided, a minimum pole strength of 48kN (ultimate) 12kN (working) for the stayed pole shall apply.

Designers shall apply the Failure Containment Load Case (Clause 5. 2) for a broken stay to ensure foundation strength and pole strength are adequate to prevent buckling.

Ground stays on flood plains need to be able to withstand the dynamic impact of flood borne debris. Ground stays add an undesirable dynamic pole structure complexity for coping with long wall mine ground subsidence.

If you design a ground stay in a large animal livestock paddock, ensure an anti-rub/anti-impact cattle fence is installed. Ground stay wires being leveraged by large animals can cause conductor clashing. Animals, or human bike riders/horse riders, can be injured during large animal stock movements.

A stay, especially a ground stay, if located in cultivated paddock can be an obstruction to landowner farm machinery in cultivation and harvesting.

9.2 Pole data

9.2.1 Wood pole date table

Ausgrid Item No.	Length (m)	Nominal Working Strength (kN)	Nominal Breaking Load (kN)	Max. Allowable Tip Load (kN) (See Note 1)		Self Windage of Pole Structure Equivalent Tip Load (kN)		Default Sinking Depth (m) (See Note 3)			Min. Diameter (mm) (See Note 4)				Mass (kg)
				Max. Wind & Failure Contain.	Sustained	Max. Wind	Failure Contain.	Weathered Rock	Very Stiff Clay	Dense Sand	Butt	Ground Line	Tip	Bored Hole w. concrete	
1	8	4	16	9. 86	5. 62	0. 85	0. 16	1. 30	1. 61	2. 17	249	235	185	450	313
2		6	25	14. 79	8. 43	0. 98	0. 19	1. 49	1. 85	2. 39	283	269	219	500	410
3		8	33	19. 71	11. 24	1. 10	0. 21	1. 59	1. 96	2. 51	310	296	246	600	500
4		12	49	29. 35	16. 73	1. 26	0. 24	1. 88	2. 34	2. 81	352	338	288	600	664
5	9. 5	4	16	9. 87	5. 63	1. 09	0. 21	1. 35	1. 68	2. 22	267	251	191	500	413
6		6	24	14. 60	8. 32	1. 26	0. 24	1. 53	1. 89	2. 43	302	286	226	600	546
7		8	33	19. 51	11. 12	1. 39	0. 26	1. 71	2. 12	2. 66	331	315	255	600	663
8		12	48	28. 88	16. 46	1. 61	0. 31	2. 04	2. 54	2. 99	375	359	299	600	879
12	11	6	24	14. 44	8. 23	1. 53	0. 29	1. 53	1. 90	2. 45	318	301	230	600	694
13		8	32	19. 20	10. 94	1. 70	0. 32	1. 73	2. 14	2. 66	348	331	260	600	848
14		12	48	29. 05	16. 56	1. 99	0. 38	1. 96	2. 41	2. 89	397	380	309	600	1115
15	12. 5	4	16	9. 46	5. 39	1. 55	0. 29	1. 62	2. 02	2. 54	292	274	192	500	657
16		6	24	14. 37	8. 19	1. 83	0. 35	1. 84	2. 28	2. 77	333	315	233	600	858
17		8	32	19. 21	10. 95	2. 03	0. 39	2. 18	2. 72	3. 11	365	347	265	600	1046
18		12	48	28. 98	16. 52	2. 38	0. 45	2. 28	2. 82	3. 23	416	398	316	750	1375
19	14	6	24	14. 20	8. 10	2. 11	0. 40	1. 82	2. 25	2. 73	346	327	234	600	1042
20		8	32	19. 27	10. 98	2. 38	0. 45	2. 05	2. 55	3. 00	381	362	269	600	1260
21		12	48	28. 83	16. 43	2. 77	0. 53	2. 28	2. 82	3. 24	433	414	321	750	1658
22	15. 5	6	24	14. 18	8. 08	2. 41	0. 46	1. 89	2. 36	2. 85	359	339	235	600	1232
23		8	32	19. 04	10. 85	2. 71	0. 51	2. 16	2. 68	3. 08	394	374	270	600	1488
25		12	48	28. 73	16. 38	3. 18	0. 60	2. 37	2. 95	3. 31	449	429	325	750	1962
26	17	6	23	14. 01	7. 98	2. 71	0. 51	1. 98	2. 47	2. 93	371	349	235	600	1440
27		8	32	18. 95	10. 80	3. 05	0. 58	2. 09	2. 59	3. 02	408	386	272	750	1749
31		12	47	28. 46	16. 22	3. 58	0. 68	2. 49	3. 09	3. 43	464	442	328	750	2284

Ausgrid Item No.	Length (m)	Nominal Working Strength (kN)	Nominal Breaking Load (kN)	Max. Allowable Tip Load (kN) (See Note 1)		Self Windage of Pole Structure Equivalent Tip Load (kN)		Default Sinking Depth (m) (See Note 3)			Min. Diameter (mm) (See Note 4)				Mass (kg)
				Max. Wind & Failure Contain.	Sustained	Max. Wind	Failure Contain.	Weathered Rock	Very Stiff Clay	Dense Sand	Butt	Ground Line	Tip	Bored Hole w. concrete	
32	18. 5	6	23	13. 93	7. 94	3. 02	0. 57	2. 05	2. 56	3. 00	382	359	234	600	1668
33		8	31	18. 84	10. 74	3. 41	0. 65	2. 16	2. 70	3. 10	420	397	272	750	2012
37		12	48	28. 55	16. 27	4. 00	0. 76	2. 58	3. 22	3. 50	479	456	331	750	2634
38	20	8	31	18. 83	10. 73	3. 76	0. 71	2. 25	2. 79	3. 18	432	408	272	750	2298
39		12	47	28. 41	16. 20	4. 42	0. 84	2. 67	3. 34	3. 58	492	468	332	750	2999
40	21. 5	8	31	18. 62	10. 61	4. 09	0. 78	2. 31	2. 91	3. 26	442	417	270	750	2593
41		12	47	28. 22	16. 09	4. 83	0. 89	2. 76	3. 45	3. 66	504	479	332	750	3376
42	23	12	47	28. 14	16. 04	5. 27	1. 00	2. 85	3. 56	3. 74	516	490	332	750	3763
9	10 Stay Poles	25	100	60. 00	34. 00	2. 15	0. 40	2. 30	2. 80	3. 20	485	472	388	750	1633
10		35	140	84. 00	47. 60	2. 36	0. 44	2. 45	3. 00	3. 40	537	524	440	750	2042
11		45	180	108. 00	61. 20	2. 54	0. 47	2. 60	3. 15	3. 75	584	571	487	750	2451

Notes:

1. Max. Allowable Tip Loads are generally based on Strength Reduction Factors of 0. 60 for Strength Limit and 0. 34 for Serviceability Limit. Strength Limit is usually the limiting factor, but serviceability limit may be of concern on tight-strung rural lines.
2. Self windage of pole is based on average above-ground diameter for SD2 class pole and includes a factor of 1. 1 to allow for windage of crossarms, insulators and other fittings. A design max. wind pressure of 1300Pa has been used, and for failure containment 240Pa. The centre of pressure is assumed to be at a point halfway between the tip and ground line.
3. Default Sinking Depths shown are based on typical soil bearing strengths, allowing for concrete backfill with the bore diameters shown and using the Brinch Hanson method, applying the following parameters:

   Weathered Rock (Shale Class V) C = 250 kPa γ = 18. 0 kN/m3

   Very Stiff Clay C = 125 kPa γ = 18. 6 kN/m3

   Dense Sand φ = 38° γ = 19. 0 kN/m3

   (C = Shear strength, γ = Weight/Density, φ = Angle of Internal Friction)

   Designs where any significant departure from the above listed soil types is expected should utilise actual cone penetration test data and or apply the methodology described in Clause 9.3 of this Manual. Note that this methodology allows for different soil types, backfill and bore diameters.

   See also NS128 Specification for Pole Installation and Removal Clause 9.3 Pole Sinking Depths.
4. Pole diameters and masses assume strength class SD2 Timber. Diameters for SD3 class poles will be larger.

9.2.2 Concrete poles

<Under Development>

9.2.3 Steel pole date table

<Under Development>

9.3 Foundations

General approach

Ausgrid requires pole foundations to be designed to match the tip strength and height of the pole.

The pole foundation design typically specifies:

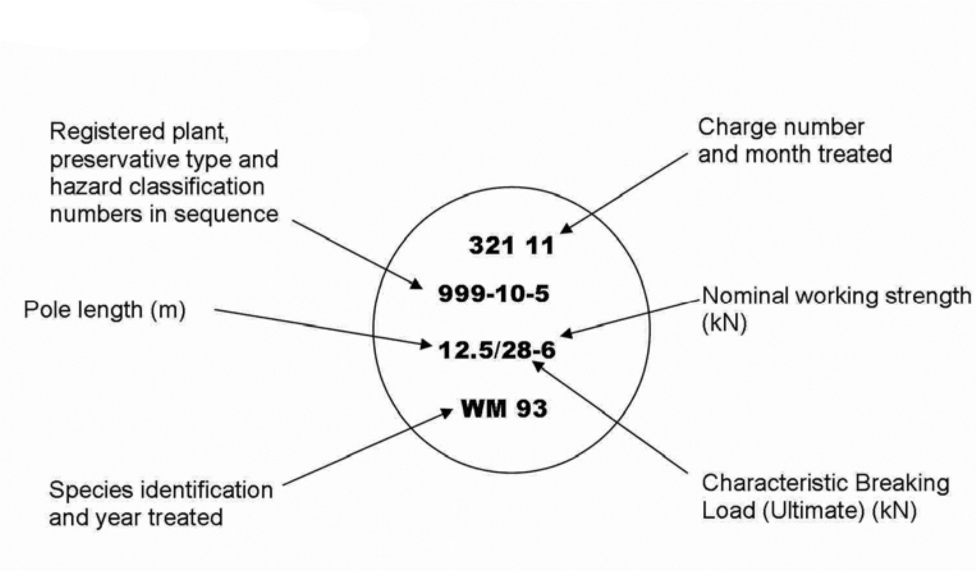
- the sinking or embedment depth of the pole in the ground,
- the type of backfill, and
- the size of the auger to be used to bore the hole in the ground.

Ausgrid has developed a Foundation Design Spreadsheet for this purpose. It employs the Brinch Hansen method of foundation design and allows for entry of detailed soil parameters, even multi-layer soils. This spreadsheet is available from the Ausgrid website www.ausgrid.com.au.

For simple distribution designs in areas where soils are reasonable, or where designers do not have access to the spreadsheet, the Pole Data table in Clause 9.2 provides conservative default foundation designs for three types of soil.

For sites with very loose soil or swampy conditions it is recommended that a civil engineer be consulted to design a special foundation to suit. This may involve use of caissons, piles, 'logs' or cross members below ground. The process for variations from network standards (NS181) is to be followed for foundation designs of this type.

9.4 Wood pole disks



DISC LAYOUT

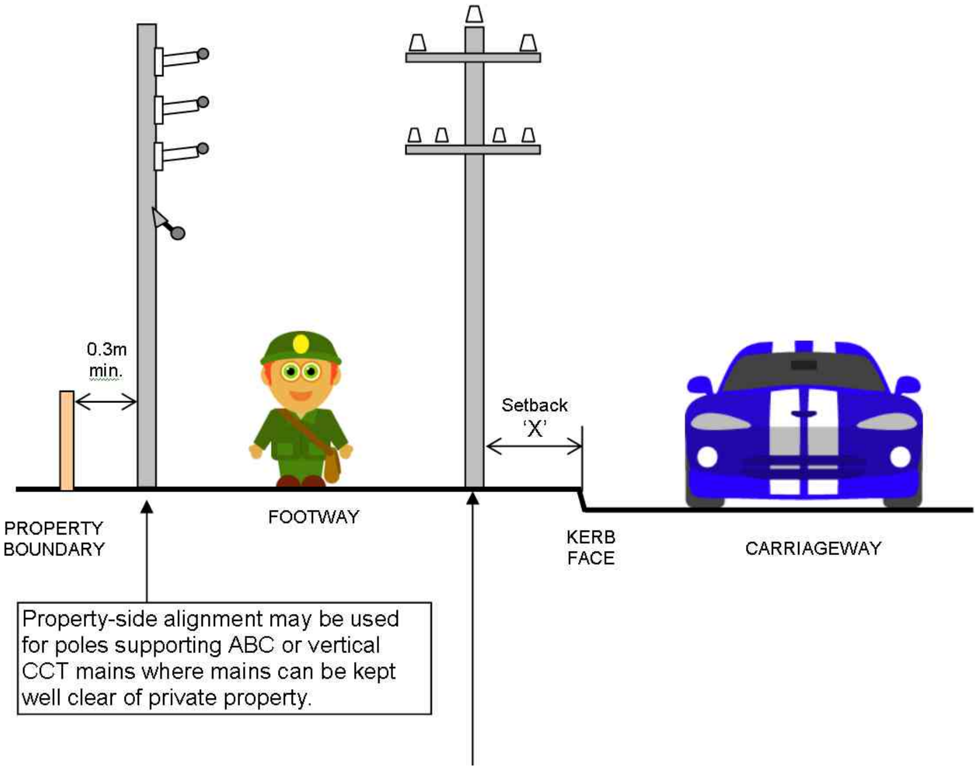
Species Code	Standard Trade or Common Name	Botanical Name Genus/Species	Strength Group to AS/NZS 2878:2000
BI	Broad Leafed Red Ironbark	Eucalyptus siderophloia	S1
GI	Grey Iron Bark	Eucalyptus paniculata northern	S1
GG	Grey Gum	Eucalyptus punctata northern	S1
WM	White Mahogany	Eucalyptus acmenioides northern	S2
TW	Tallowwood	Eucalyptus microcorys northern	S2
GB	Grey Box	Eucalyptus hemiphloia	S2
SG	Spotted Gum	Eucalyptus maculate	S2
NI	Narrow Leafed Red Ironbark	Eucalyptus crebra	S2

Notes:

1. The pole identification disc is located 4.0 metres from the butt.
2. Pole identification discs are attached to treated poles only.
3. Strength group – S1 is strongest; S3 is weakest.
4. For Old Wood Pole Discs refer to NS145, especially see Annexure A for 'Information on Ausgrid Timber Poles'. (Also refer to NS128 and specific Wood Pole Supplier's MSDS, eg Koppers)

9.5 Pole positioning

9.5.1 Alignment/setback

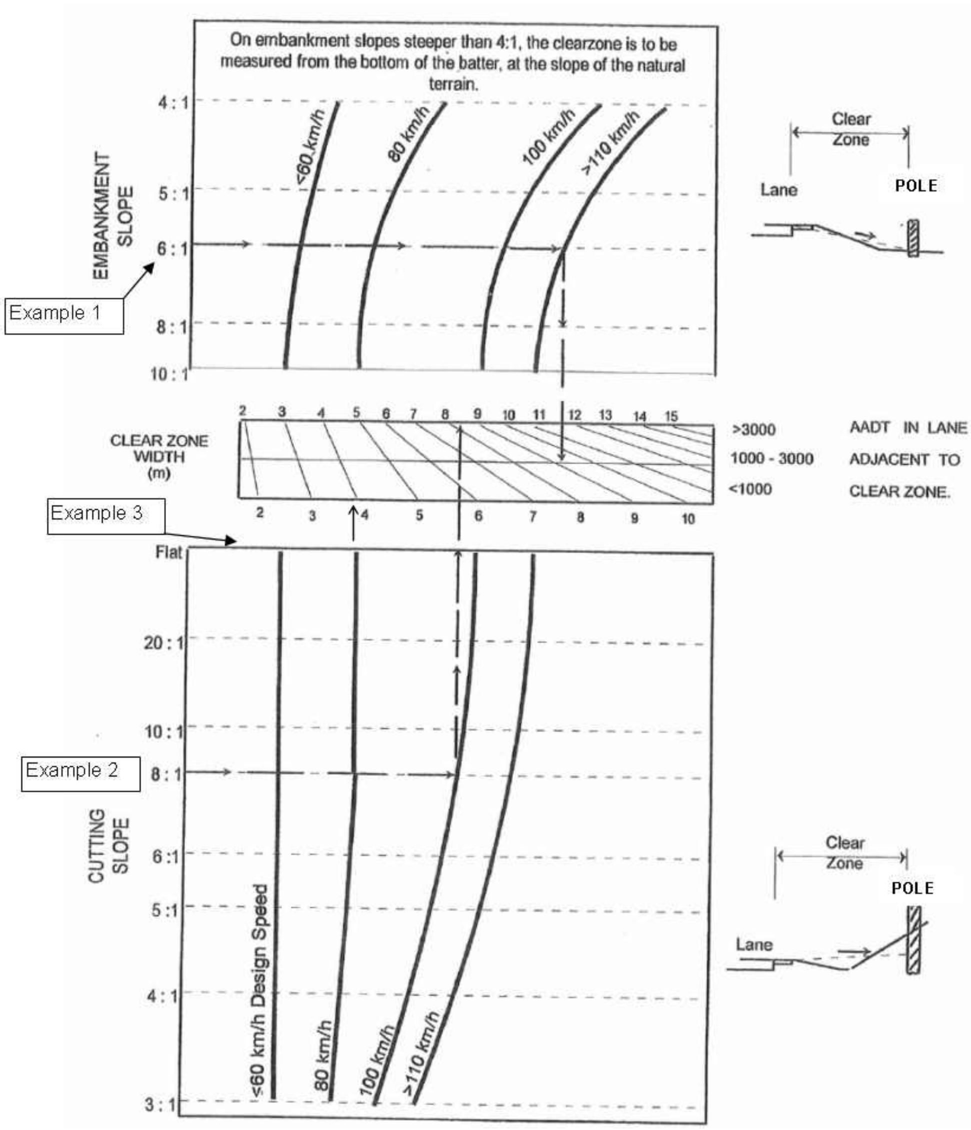


<table>
<tr><th colspan="3">SITUATION</th><th>'X'</th></tr>
<tr><td colspan="3">Main Roads, State Highways, Freeways</td><td>Maintain Clear Zone as per RTA requirements - see next sheet
2. 5m minimum except where behind guard rail</td></tr>
<tr><td rowspan="3">Other Roads</td><td colspan="2">Narrow footways (<5m)</td><td>0. 5m where practicable
0. 300 m minimum</td></tr>
<tr><td rowspan="2">Wide footways (>5m)</td><td>Sydney and Central Coast Areas</td><td>2. 5m</td></tr>
<tr><td>Newcastle and Upper Hunter Areas</td><td>1. 5m</td></tr>
</table>

Notes

1. Setbacks and locations shown are a simplified general guideline only and are subject to local authority requirements and coordination with other services, eg water mains. See NS130 Annexure C for utility allocations in various regions as per Streets Opening Conference.
2. Ensure that there is at least 300mm clearance around poles to facilitate below-ground inspection and treatment.
3. When replacing or installing isolated poles on an existing line, it may be more practical to use the existing alignment than a new alignment in order to keep line straight.
4. On arterial roads where poles support streetlights, use of the property-side alignment may be impractical because of excessive distance from carriageway.
5. Do not confuse setback to pole face with that to pole centre. Pole diameter/radius can be obtained from pole data in Clause 9. 2.

9.5.2 RTA clear zone – no poles except those behind a guard rail



Example 1: Ground slopes down from road to pole on a 6:1 slope, traffic volume 2000 vehicles per day, >110km/h => Clear Zone = 9. 0m

Example 2: Ground slopes up from road to pole on a 8:1 slope, high traffic volume >3000 vehicles per day, 100km/h => Clear Zone = 8. 3m

Example 3: Flat ground, low traffic <1000 vehicles per day, 80km/h. => Clear Zone = 4. 0m

9.5.3 Longitudinal positioning considerations

CORRECT	WRONG/AVOID
In urban areas, position poles on the footway in line with alternate lot boundaries so that all lots can be serviced and so that there is minimal impact to house frontages. (On large lots, still try to align poles with lot boundaries.)	Avoid locations that will cause mains or services to cross private property. Also, minimise the number of spans of mains or services crossing roadways.
	Avoid locations that will obstruct views from houses. This is especially important where there is pole-mounted plant.
Straight lines are preferable, both for minimising forces on structures and aesthetically.	Minimise deviation angles.
	Avoid placing poles within 1. 5m from existing driveways or so as to block gateways or access tracks on rural properties.
	Avoid switching sides of the road more often than is necessary, particularly if phase transpositions are required,
Keep span lengths reasonably similar if practicable; otherwise strain points will be needed. (Remember 2:1 rule.)	
Coordinate positions with road lighting requirements.	
Position poles so as to minimise vegetation clearing.	
	Avoid locations where they are likely to impede the vision of motorists or where they are likely to be struck by errant vehicles, eg on a sharp corner, or the outside radius of a tight curve.
On undulating ground, poles are best placed on the tops of ridges, or on the 'shoulders' either side of a gully.	Avoid placing poles at the bottom of a gully. Not only is this inefficient, it also creates problems with uplift. Also, after heavy rain the gully may become a watercourse and foundation may be jeopardised.
	Avoid placing poles in swampy ground or loose sand where the foundation will be poor.
	Avoid locations close to the top of an embankment where foundation strength may be compromised.
	Avoid locations where excavation is difficult, e. g. on rocky ridges.
Where poles are earthed, ensure adequate clearances from telecommunications earths.	Avoid locations where there are numerous or sensitive underground services, e. g. a congested footpath with an major optical fibre cable.
Ensure good access to poles, especially for poles with switches and other plant.	Avoid locations where access is difficult, e. g. steep embankments, poor quality access tracks, crops, heavy vehicular traffic, median strips, behind locked gates.

9.6 Worked examples

EXAMPLE 1 – LV Pole Termination in Rocky Ground

A circuit of LV mains is to terminate on a pole. The ground is primarily rock (shale), with only a thin layer of top soil. The mechanical loading applied to the tip of the pole by the conductors is as follows:

9. 96kN Max. Wind Load

3. 51kN Sustained Load

Select a suitable pole and foundation and determine if a stay is required.

From Clause 9.1.1 we note that an 11m pole is normally used for LV mains.

We are hopeful that we can avoid a stay. Let us select a 6kN Working Strength / 24kN Ultimate Strength pole and see if it is adequate. If not, we will go up a size or two.

Let us refer to the wood pole table in Clause 9.2.1.

EA Item No.	Length (m)	Nominal Working Strength (kN)	Nominal Breaking Load (kN)	Max. Allowable Tip Load (kN) (See Note 1)		Self Windage of Pole Structure Equivalent Tip Load (kN)		Default Sinking Depth (m) (See Note 3)		
				Max. Wind & Failure Contain.	Sustained	Max. Wind	Failure Contain.	Weathered Rock	Very Stiff Clay	Dense Sand
1	8	4	16	9.86	5.62	0.85	0.16	1.30	1.61	2.17
2		6	25	14.79	8.43	0.98	0.19	1.49	1.85	2.39
3		8	33	19.71	11.24	1.10	0.21	1.59	1.96	2.51
4		12	49	29.35	16.73	1.26	0.24	1.88	2.34	2.81
5	9.5	4	16	9.87	5.63	1.09	0.21	1.35	1.68	2.22
6		6	24	14.60	8.32	1.26	0.24	1.53	1.89	2.43
7		8	33	19.51	11.12	1.39	0.26	1.71	2.12	2.66
8		12	48	28.88	16.46	1.61	0.31	2.04	2.54	2.99
12	11	6	24	14.44	8.23	1.53	0.29	1.53	1.90	2.45
13		8	32	19.20	10.94	1.70	0.32	1.73	2.14	2.66
14		12	48	29.05	16.56	1.99	0.38	1.96	2.41	2.89
15	12.5	4	16	9.46	5.39	1.55	0.29	1.62	2.02	2.54
16		6	24	14.37	8.19	1.83	0.35	1.84	2.28	2.77
17		8	32	19.21	10.95	2.03	0.39	2.18	2.72	3.11
18		12	48	28.98	16.52	2.38	0.45	2.28	2.82	3.23

We see that the self-windage for an 11/6 pole is 1. 53kN. Therefore we have a total Max. Wind Load of 9. 96 + 1. 53 = 11. 49kN.

We also notice from the table that the maximum allowable tip loads for an 11/6 pole are:

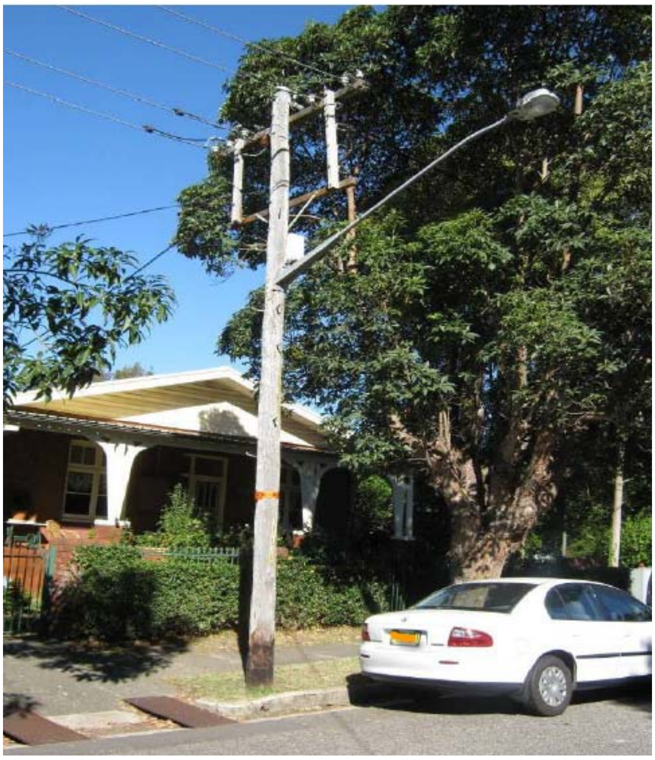
14. 44kN Max. Wind Condition (>11.49kN applied)

8. 23kN Sustained (>3.51kN applied)

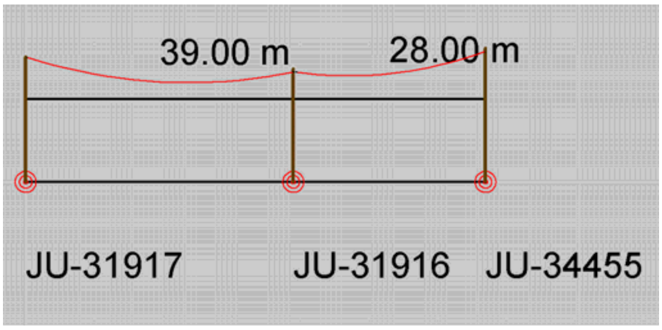
Clearly, the tip strength is greater than the applied load for both load cases, so there is no need to increase pole size or fit a stay to the pole.

Normally we would use the Foundation Design Spreadsheet (PEC)to design the foundation, but let us continue to use the wood pole data table in this instance. For weathered rock, we see that a minimum sinking depth of 1. 53m is required, assuming that a full depth concrete foundation is employed with a bored hole diameter of 600mm.

EXAMPLE 2 – Determination of Pole Foundation Requirements using PEC and Mapped Soil Data.



Replacement of condemned pole JU 31916 in the Hamilton, Newcastle area where sand and soft clays are prevalent. Conductor: 39m span of MERCURY and 28m span of ABC 4x95mm^{2} - both at 4% UTS.



An 11m pole is required. Note that the profile indicates there is sufficient ground clearance to allow for a deeper pole embedment.

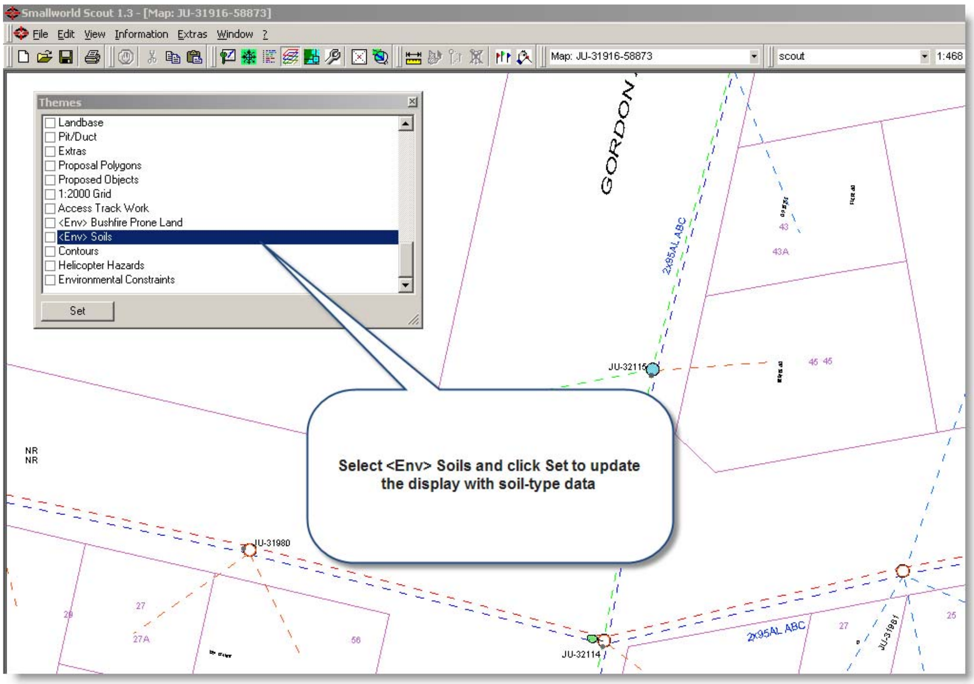
Component	Sustained Load (F)	Urban Wind Load
Brace-Xarm-Flat-40x5x690mm	0.68	0.74
Insul-LV ABC Terminination	2.02	9.74
Xarm-Wood-150x100x2700mm+Brace-2x690mm_1	43.78	71.81
Insul-LV-Termination-Ceramic	4.22	15.11
Insul-LV-Termination-Ceramic	4.22	15.12
Brace-Xarm-Flat-40x5x690mm	0.70	0.19
Insul-LV-Termination-Ceramic	4.22	15.11
Insul-LV ABC Terminination	15.16	36.57
Insul-LV-Termination-Ceramic	4.22	15.11
Insul-LV ABC Terminination	2.02	9.58
11.0m06kN-TT	9.51	52.62

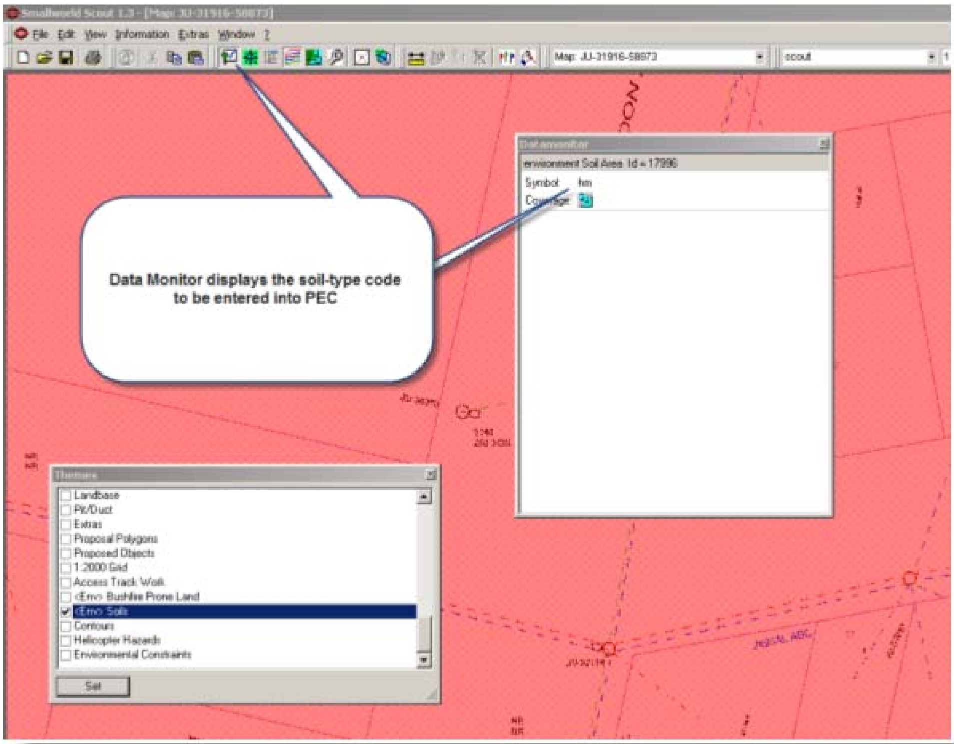
The structural analysis indicates a 24kN Ultimate (6kN Working) pole loaded to 52.6% of design capacity.

Note: That allowing for street lighting brackets, the design load of the structure is unlikely to exceed 60% of the design capacity over the project life.

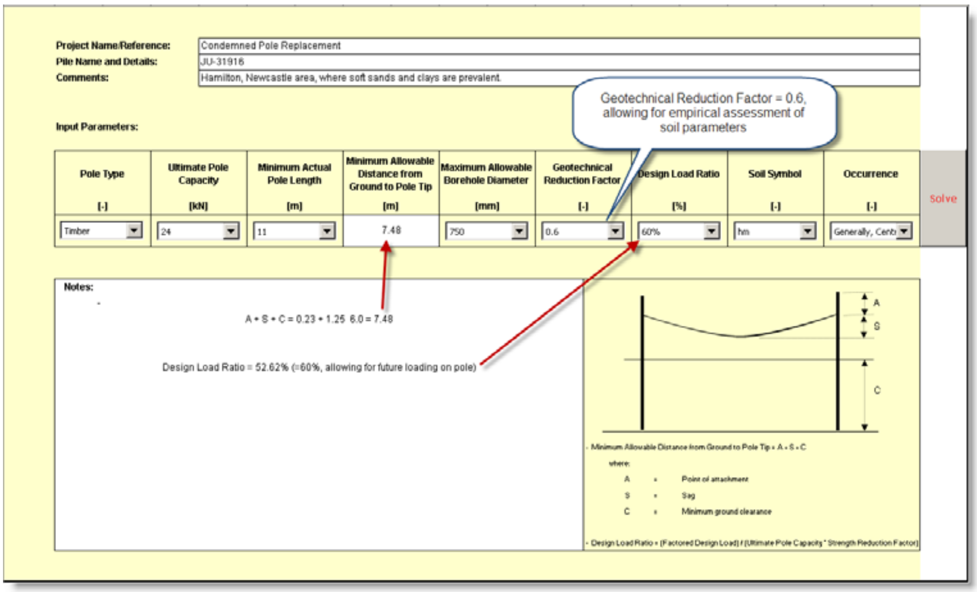
Foundation design process

Ausgrid geotechnical data is contained within the Smallworld Scout GIS. The GIS data base provides a code which allows for the identification of soil strength design parameters at the pole site:





Enter relevant details to the ‘Input’ sheet of PEC:



Notes:

1. The Maximum Allowable distance for Ground to Pole Tip = A + S + C =7.48m.This allows PEC to trial successive embedment depths until this value is reached, and if the foundation is still inadequate, the next nominal pole length is selected.
2. Soil strength data is based on empirical assessment rather than testing, therefore Geotechnical Reduction Factor = 0.6.

Entry of the ‘Soil Symbol’ (hm) and the ‘Occurrence’ (related to the local terrain), automatically populates the relevant soil strength parameters in the ‘Soil Layers’ sheet:

No of Layers	2
Depth of Water Table	12 [m]

Layering Details

Layer No.	Depth [m]		Soil Type	Soil Description	Soil Parameters	C	φ	γ
	From	To				[kPa]	[deg]	[kN/m3]
1	0	5	Sand	Loose to Medium Dense	Automatic	0.0	30.0	17.5
2	5	20	Clay	Soft to Firm	Automatic	28.1	0.0	16.2

These inputs can be manually adjusted if more detailed information, such as Cone Penetration Test data, is available.

Clicking on the ‘Solve’ button in the ‘Input’ sheet provides a set of foundation solutions in the ‘Results’ sheet:

Project Name/Reference:	Condemned Pole Replacement
Pile Name and Details:	JU-31916
Comments:	Hamilton, Newcastle area, where soft sands and clays are prevalent.

Backfill type	Design Specification	Bore Diameter 450	500	600	750	900	1050	1200	1350	1500
Concrete	Pole Length	Not applicable	Not applicable	11	11	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Pole Butt Diameter	Not applicable	Not applicable	309	309	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Pole Head Diameter	Not applicable	Not applicable	203	203	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Required Penetration	Not applicable	Not applicable	2.94	2.79	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Compacted Selected Backfill	Pole Length	Not applicable	Not applicable	11	11	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Pole Butt Diameter	Not applicable	Not applicable	309	309	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Pole Head Diameter	Not applicable	Not applicable	203	203	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Required Penetration	Not applicable	Not applicable	3.11	3.01	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Excavated Soil	Pole Length	Not applicable	Not applicable	11	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Pole Butt Diameter	Not applicable	Not applicable	309	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Pole Head Diameter	Not applicable	Not applicable	203	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Required Penetration	Not applicable	Not applicable	3.42	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

* Note: If the pole length is typed in red, it means that the selected suitable pole is different from the initial nominated pole.

Notes:

1. An allowance is made for 100mm clearance between the pole butt and the wall of the bored hole (i.e., minimum bore diameter = pole butt diameter + 200mm). There are therefore no solutions for a 450mm and 500mm bore.

2. The foundation solutions include for three types of backfill:

- Excavated soil
- Compacted Selected Soil (equivalent to road base)
- Concrete (preferably supplied as a premix: Standard Strength Grade = 25MPa, Maximum Nominal Aggregate size = 20mm)

Assume that other underground services restrict the maximum bore diameter to 600mm.

Assume also that Cone Pressure and Borehole tests have been conducted at the pole site, the results of which are entered manually in the ‘Soil Layers’ sheet:

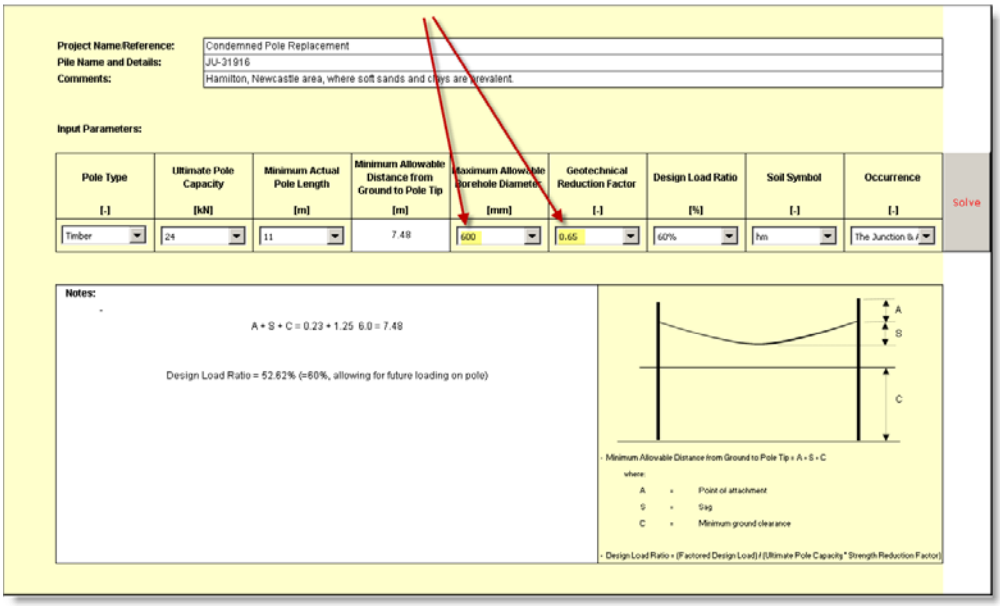
No of Layers	2	
Depth of Water Table	12	[m]

Layering Details

Layer No.	Depth [m] From	To	Soil Type	Soil Description	Soil Parameters	C [kPa]	φ [deg]	γ [kN/m3]
1	0	4.5	Sand	Loose to Medium Dense	Manual		31.0	17.8
2	4.5	20	Clay	Soft to Firm	Manual	28.2		16.3

Change the Maximum Bore Diameter to 600 and

Change the Geotechnical Reduction Factor to 0.65 (conventional soil testing):



Click on the 'Solve' button (which appears after any input is changed) to calculate a new set of solutions:

Project Name/Reference:	Condemned Pole Replacement
Pile Name and Details:	JU-31916
Comments:	Hamilton, Newcastle area, where soft sands and clays are prevalent.

Backfill type	Design Specification	Bore Diameter 450	500	600	750	900	1050	1200	1350	1500
Concrete	Pole Length	Not applicable	Not applicable	11	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Pole Butt Diameter	Not applicable	Not applicable	309	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Pole Head Diameter	Not applicable	Not applicable	203	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Required Penetration	Not applicable	Not applicable	2.77	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Compacted Selected Backfill	Pole Length	Not applicable	Not applicable	11	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Pole Butt Diameter	Not applicable	Not applicable	309	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Pole Head Diameter	Not applicable	Not applicable	203	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Required Penetration	Not applicable	Not applicable	2.94	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Excavated Soil	Pole Length	Not applicable	Not applicable	11	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Pole Butt Diameter	Not applicable	Not applicable	309	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Pole Head Diameter	Not applicable	Not applicable	203	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Required Penetration	Not applicable	Not applicable	3.21	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

* Note: If the pole length is typed in red, it means that the selected suitable pole is different from the initial nominated pole.

The set of solutions allows the Designer to choose the type of backfill, which may be influenced by economics or constructability.

Pole embedment depth, borehole size and type of backfill should be noted on the Construction Drawing.

In this case, influenced by the practicalities of boring a hole to greater depths in poor holding soils, the most suitable solution specified on the construction plan is an embedment depth of 2.77m with concrete backfill, using a 600mm auger.

9.7 Engineering notes

Wood pole strength

For line design, we are primarily concerned with the tip load capacity of the pole, i. e. its capacity to withstand an overturning bending moment[2]. However, combined bending moment and compressive strength can be a limitation for wood poles supporting very heavy plant items.

The ultimate tip strength (kN) of a solid, round wood pole can be taken to be:

$$F_T = \frac{k\, f'_b\, \pi\, D^3 \times 1000}{32\, h}$$

where:

k = factor accounting for load duration, degradation, shaving, immaturity and processing (use value of 0. 8 for assessing an in-service pole)

f'_b = characteristic strength in bending – dependent on AS2209 strength class (MPa)

100MPa for S1, 80MPa for S2, 65MPa for S3

D = ground line diameter (m)

h = tip height above ground (m)

For additional information, see Reference 23 Annexure F Timber poles. (SAA AS7000 Vol 1 is approved for publication)

To determine the maximum wind load, Ausgrid applies a strength factor of 0. 6 to the ultimate strength of the pole. For the sustained load limit, Ausgrid applies a strength factor of 0. 35 (refer Clause 5.4).

In-service wood poles

Where it is proposed to increase the tip load of an existing wood pole then a pole inspection should be carried out by Ausgrid in accordance with applicable current Network Standards. Ausgrid may not accept the risk of a significant loading increase on an existing pole.

The typical proposed load increase may be due to adding new mains (not services), upgrading or re-tensioning conductors, the counter loading impact of a proposed undermining of pole foundation strength or trenching/civil works to install an underground cable.

Ausgrid Network Standard NS145 needs to be applied for timber poles.

The pole should be inspected below ground. If significant decay is found internally or externally, then the pole diameter should be measured on an axis aligned with the proposed new resultant tip load direction. Any external decay should be subtracted from the diameter measurement. The ultimate tip load can be calculated using the formula above.

Where an internal hollow is detected of diameter *d*, then the ultimate tip strength (kN) may be calculated as follows:

$$F_T = \frac{k\, f'_b\, \pi\, (D^4 - d^4) \times 1000}{32\, h\, D}$$

This calculated value should be used as a guide only, as to whether the pole should be replaced as part of the design.

Ausgrid's practice is to change out wood poles at 50% remnant strength. The pole degradation factor (k_d) takes into account the **line reliability** that is required to be intact over a maximum period

[2] Bending moment is the product of load and height above the pivot point, which for simplicity is assumed to be ground line.

required to replace the pole. Note that this factor is related to the 50% remnant strength of the pole and not related to time. In other words: allowance for pole degradation is related to the pole maintenance regime and not remnant life of the pole, which is indeterminate.

Part of the process of Ausgrid's pole inspection practice is the recording of sufficient measurements to calculate remnant strength. The accuracy of these measurements, and therefore the estimated remnant strength is too unreliable to use as the ultimate capacity in a design using existing poles.

The designer should use the nominal capacity of the pole when new and apply the design loads and strength reduction factors appropriate to a new structure, these being related to the full (rather than partial) nominal pole life of 50 years. In other words, apply the design parameters as if it is a new structure.

The designer may judge whether the pole in question is sufficiently aged and or deteriorated to warrant replacement in any case, but should not use remnant strength as a basis for design if it is decided to use the existing structure.

Reinforced poles

Poles are reinforced according to NS145, on the basis that the pole is suitable for another ten year's life at the existing loading.

Any prospective change to mechanical loading of the asset will require a new pole to be considered as part of the design process.

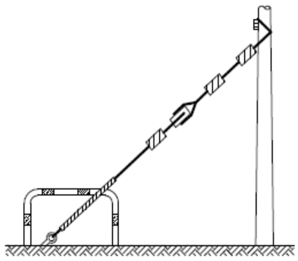
10.0 STAYS

10.1 Stay type selection

Ground Stay

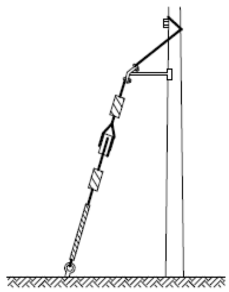
Used for most applications.

Fit guard for stays where likely to cause injuries to pedestrians, cattle, horses or other large animals.



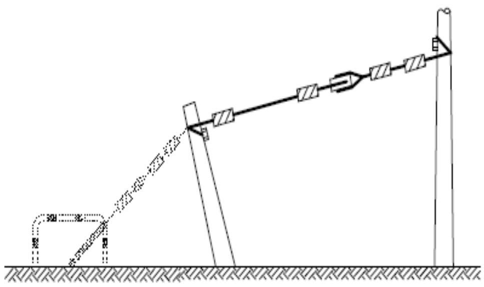
Sidewalk Stay

Used where there is insufficient space for a ground stay e. g. where the stay is confined to the width of a footpath. They have limited capability and are less efficient than a regular ground stay.



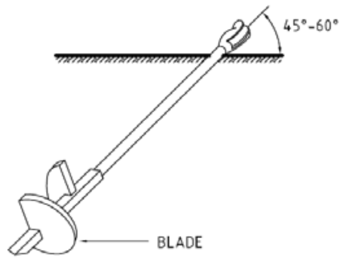
Pole (Aerial) Stay

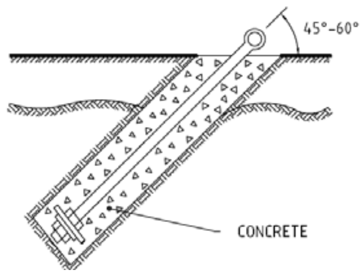
Used where a ground stay is unsuitable e. g. crossing a roadway. In some cases, the stay pole may also need to be supported with a ground stay.

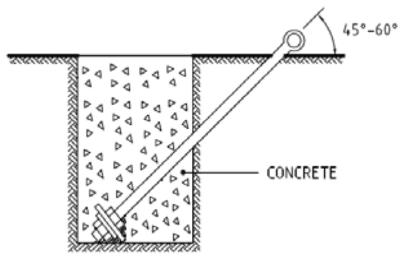


10.2 Ground anchor selection

10.2.1 Ground anchor type







Screw Anchor
Used for most soil types
(Soil Classes 2 – 7)

Rock Anchor
Used in bedrock and cemented sand where screw anchors cannot be driven to the required depth.
(Soil Class 1)

Mass Concrete
Used in very poor soil or where drainage is poor e. g. swampy areas, loose sand or to avoid interfering with underground services. (Soil Class 8, also Classes 6 and 7 if necessary)

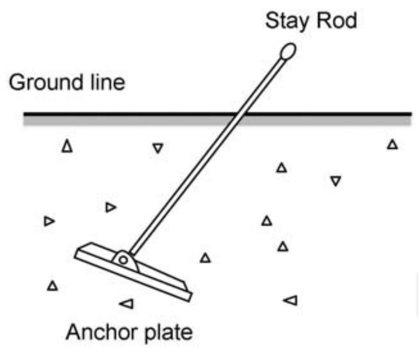
Screw Anchor Strength and Minimum Installation Torque

No. OF BLADES	BLADE DIAMETER	TYP. USE	ELEMENT	GOOD SOIL		AVERAGE SOIL		POOR SOIL	
				2	3	4	5	6	7
1 SINGLE	200mm	GOOD SOIL	Strength (kN)	92	76	64	48	36	20
			Install Torque (N. m)	7600	5600	3700	2300	1300	400
			No. Shear Pins	8	6	4	3	3	
	250mm	AV. SOIL	Strength (kN)	-	84	68	56	40	24
			Install Torque (N. m)	-	6100	4200	2500	1500	600
			No. Shear Pins	-	7	6	5	3	
	300mm	POOR WET SOIL	Strength (kN)	-	92	76	64	48	32
			Install Torque (N. m)	-	6800	4400	3100	1750	800
			No. Shear Pins	-	7	5	4	3	
2 DOUBLE	200mm	POOR DRY SOIL	Strength (kN)	-	-	96	76	56	36
			Install Torque (N. m)	-	-	5700	3800	2200	1800
			No. Shear Pins	-	-	6	4	3	
	250mm	POOR DRYSOIL	Strength (kN)	-	-	108	88	68	48
			Install Torque (N. m)	-	-	6000	4100	2500	900
			No. Shear Pins	-	-	7	6	3	

Soil Category	Soil Class	Description
Good	1	Solid bedrock—USE ROCK ANCHOR
	2	Hardpan; dense fine sand; compact gravel; laminated rock; slate schist; sandstone
	3	Hard clay; dense sand; shale; broken bedrock; compact clay-gravel mixtures
Average	4	Medium dense sand gravel mix; very stiff to hard clays and silts
	5	Medium dense coarse sand or sandy gravel; stiff to very stiff silts and clays
Poor	6	Loose to medium dense sand; firm to stiff clays and silts
	7	Medium stiff clay; loose sand; fill; silt
	8	Soft clay; very loose sand; swampy ground; humus; saturated silt — USE MASS CONCRETE ANCHOR

10.2.2 Manta ray driven tipping plate soil anchor election guide - load capacity (kN)

Soil Class	Soil Description	MR-88	MR-4	MR-3	MR-2	MR-1	MR-SR	MK-B
1	Very dense sands, compact gravel	45	71	89	125 - 178	178	Not used	Not used
2	Dense fine compacted sand, very hard silt or clay.	27 - 45	40 - 71	76 - 89	93 - 125	160 - 178	178	Not used
3	Dense clay, sand and gravel hard silt and clay	18 - 27	27 - 40	53 - 80	67 - 98	107 - 160	142 - 178	178
4	Medium dense sandy gravel, stiff to hard silts and clays	13 - 18	20 - 25	40 - 62	53 - 80	80 - 89	107 - 151	142 - 178
5	Medium dense coarse sand and sandy gravel, stiff to very stiff silts and clays	9 - 13	16 - 20	31 - 40	40 - 53	67 - 89	80 - 106	107 - 142
6	Loose to medium dense fine to coarse sand, firm to stiff clays and silts	7 - 11	11 - 18	22 - 36	31 - 44	44 - 67	62 - 80	89 - 106
7	Loose fine sand, alluvial, soft clays, fine saturated silty sand.	4 - 7	7 - 11	13 - 22	22 - 36	36 - 53	40 - 62	58 - 89
8	Peat, organic silts, inundates, silts, flyash	0. 9 - 4	1. 3 - 7	3. 5 - 13	9 - 22	13 - 37	18 - 53	27 - 71



Manta Ray Installation

Anchor plate is aligned with the stay rod when driven into the ground.

Anchor plate pivots to the position shown when the stay rod is then partially retracted.

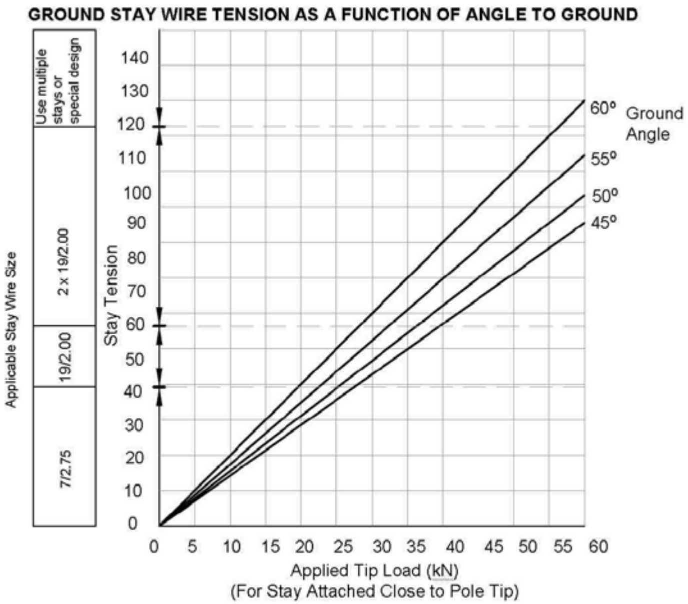
10.3 Stay wire sizing

10.3.1 Ground stays

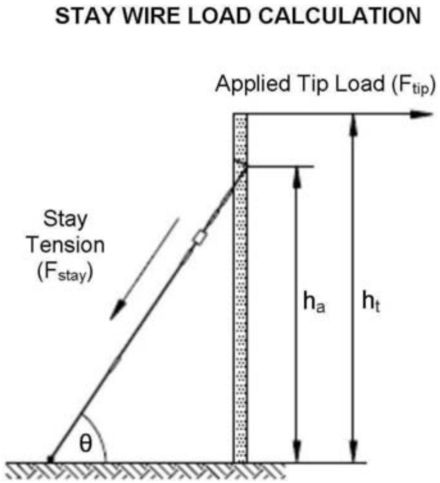
Stay Wire Sizes and Capacity

Steel Stay Wire	Stay Wire Breaking Load (UTS)	Maximum Design Load (Strength Factor 0. 8)
7/2. 75	49kN	39. 2kN
19/2. 00	70. 5kN	
2 x 19/2. 00	140. 0kN	112. 0kN

Ground Stay Wire Tension as a Function of Angle to Ground



Applied Tip Load (kN)
(For Stay attached close to Pole Tip)



Stay wire load is affected by:

- angle of stay to ground—preferred angle range is 45° - 60°
- attachment height—attach on pole as high as practicable.

Stay tension may be calculated as follows:

$$F_{stay} = \frac{F_{tip}}{cos\,\theta} \cdots \frac{h_t}{h_a}$$

where:

F_{stay} = Stay tension (kN)

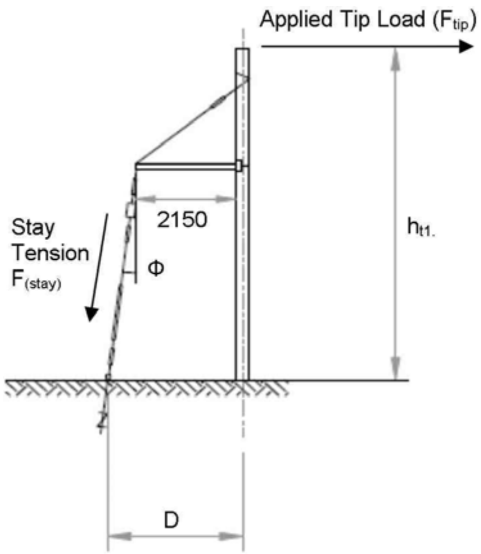
F_{tip} = Applied tip load (kN)

θ = Angle of stay to the ground

h_a = Stay attachment height above ground (m)

h_t = Pole tip height above ground (m)

10.3.2 Sidewalk stay wire sizing



Calculation Formula

$$F_{stay} = \frac{F_{tip}\,h_t}{D\cos\theta}$$

F_{stay} = Stay tension (kN)

F_{tip} = Applied tip load (kN)

Φ = Angle of stay to vertical

h_t = Pole tip height above ground (m)

D = Distance from pole centre to ground anchor (m)

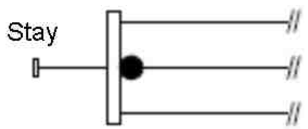
WIRE SELECTION GUIDE

Stay Wire Size	Maximum Applied Tip Load (kN)					
	Φ	0°	5°	10°	15°	20°
	D	2. 45m	3. 05m	3. 76m	4. 49m	5. 26m
7/2. 75		9. 6	11. 9	14. 5	17. 0	19. 4
19/2. 00		13. 8	17. 1	20. 9	24. 5	27. 8
2 x 19/2. 00		27. 4	34. 0	41. 5	48. 6	55. 4

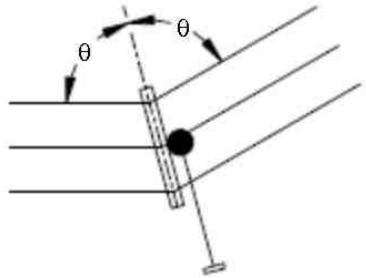
The table assumes a tip height of 10. 0 m. For significantly different heights, use the formula shown.

10.4 Stay positioning

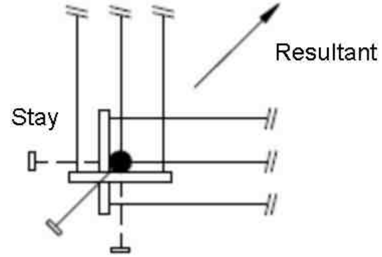
10.4.1 Single stay



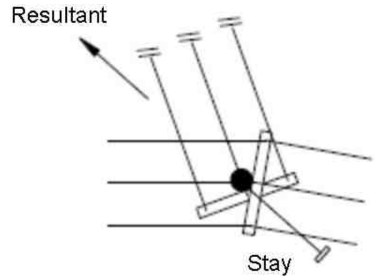
TERMINATION POLE
Stay opposite attached circuit



LINE DEVIATION POLE
Stay opposite bisector of deviation angle.

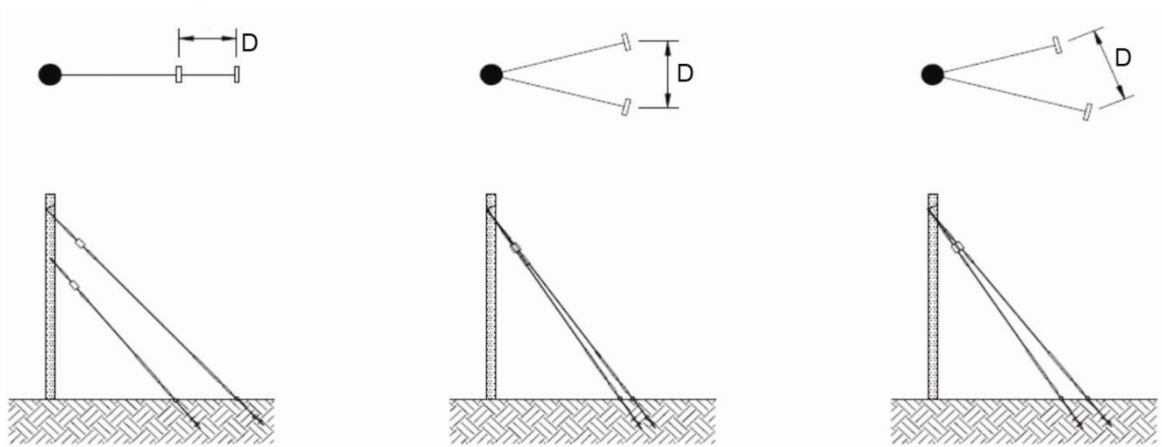


CORNER OR HEAVY DEVIATION ANGLE
Use either a single stay opposite resultant force direction or two stays – one opposite each circuit (advantages for construction).



COMPLEX POLE
Stay opposite resultant force direction.

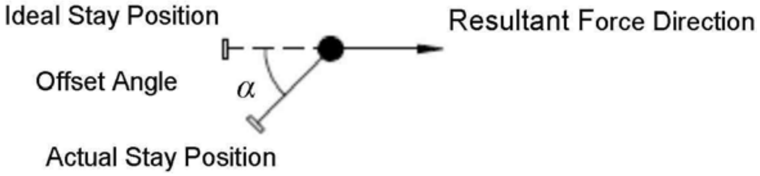
10.4.2 Dual stay



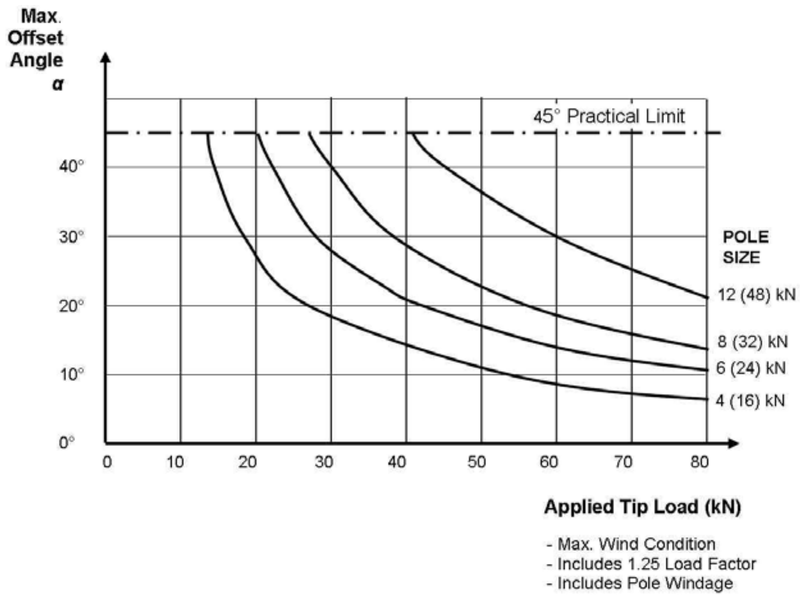
Dual stays are used where required stay tension exceeds the capacity of a single stay. As a general rule, 'D' should be greater than 2.0m for screw anchors.

Ensure that any guard rails are not positioned close to a fence in a way that could cause stock (cattle, horses etc) to become entrapped or injured.

STAY POSITIONING – OFFSET FROM IDEAL POSITION



As the stay offset angle increases, more load must be borne by the pole.



Notes:

1. This graph is provided as a general guideline for distribution poles. Precise calculations may yield slightly different results for individual cases.
2. The maximum practical offset angle shall be taken to be 45°.

10.5 Worked examples

Selection of a ground stay

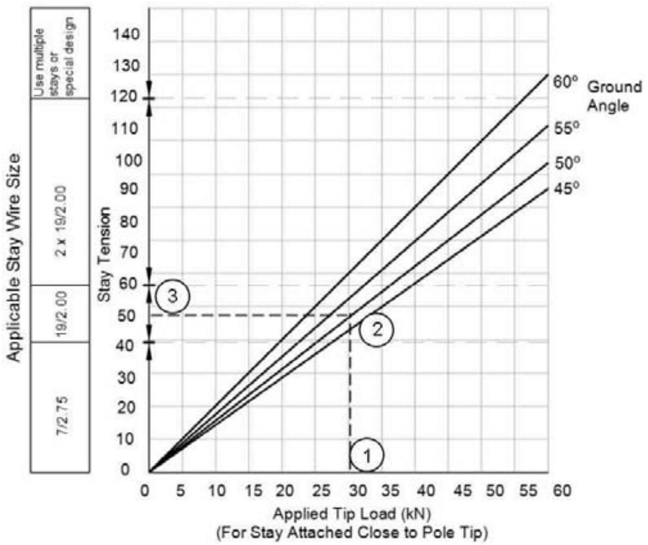
The calculated maximum wind tip load on a pole is 30. 4kN. A ground stay is to be installed at an angle of 50° to the ground. The soil is poor, a firm (but not stiff or hard) clay/silt mix. Determine the stay wire size and the screw anchor size/type.

Using the Ground Stay chart, plot the 30. 4kN tip load (point 1 on the horizontal axis).

Trace a vertical to the 50° line (point 2).

Trace horizontally to the vertical axis (point 3)

The stay tension is 47. 3kN.



(If the stay was attached significantly below the tip, scale up the effective tip load accordingly and use this to determine the stay tension e. g. if attached at 8m on a pole with a tip height of 10m, then effective tip load would be 47.3 x 10/8 = 59.1kN.)

The stay tension is greater than the maximum design breaking load for a 7/2.75 stay wire (39.2kN) but less than that for a single 19/2.00 stay (56.4kN). Hence the single 19/2.00 stay wire should be used for this application.

The soil can be categorised as Class 6 and we refer to the appropriate column of the Ground Stay Selection chart. The twin blade screw anchor would suit poor dry soil, and we note the 2 x 200mm diameter anchor has a strength of 56kN, which exceeds the 47.3kN required. Installation torque should be at least 2200N. m, or 3 shear pins.

SCREW ANCHOR STRENGTH AND MINIMUM INSTALLATION TORQUE

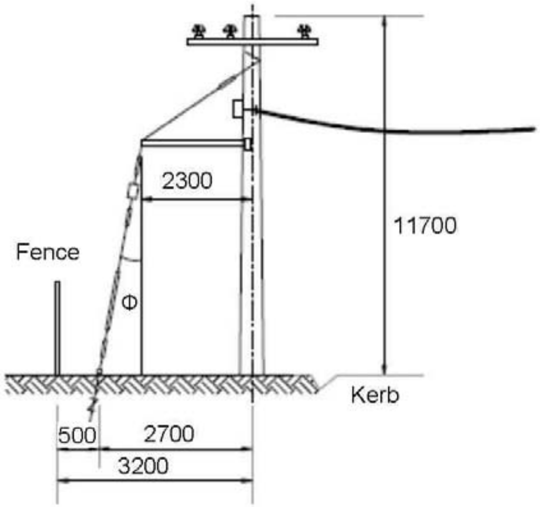
No. OF BLADES	BLADE DIAMETER	TYP. USE	ELEMENT	GOOD SOIL		AVERAGE SOIL		POOR SOIL	
				2	3	4	5	6	7
1 SINGLE	200mm	GOOD SOIL	Strength (kN)	92	76	64	48	36	20
			Install Torque (N.m)	7600	5600	3700	2300	1300	400
			No. Shear Pins	8	6	4	3	3	
	250mm	AV. SOIL	Strength (kN)	-	84	68	56	40	24
			Install Torque (N.m)	-	6100	4200	2500	1500	600
			No. Shear Pins	-	7	6	5	3	
	300mm	POOR WET SOIL	Strength (kN)	-	92	76	64	48	32
			Install Torque (N.m)	-	6800	4400	3100	1750	800
			No. Shear Pins	-	7	5	4	3	
2 DOUBLE	200mm	POOR DRY SOIL	Strength (kN)	-	-	96	76	56	36
			Install Torque (N.m)	-	-	5700	3800	2200	1800
			No. Shear Pins	-	-	6	4	3	
	250mm	POOR DRY SOIL	Strength (kN)	-	-	108	88	68	48
			Install Torque (N.m)	-	-	6000	4100	2500	900
			No. Shear Pins	-	-	7	6	3	

Selection of a sidewalk stay

An existing 14/8 pole is to have an 11kV tee-off attached. The resultant calculated maximum wind tip load for the pole will be 16kN. Due to the location of the pole, a sidewalk stay is to be installed. The pole is located in an area of good soil. The pole tip height above ground is 11.7m. The other required dimensions are indicated in the diagram below.

The pole is on a 3200m alignment. Assume that the stay anchor is installed 500mm from the fence, the pole has a diameter of 300mm and that the stay is attached 300mm below the tip.

Determine the stay wire size and screw anchor size.



Given the spar is 2150mm long and that the included angle for the top stay wire is 45°, the vertical height of the spar above the ground can be determined as 11700 – 300 – 2150 = 9250mm. The distance from the spar tip and the pole centre is 2150 + 150 = 2300. The distance between the pole centre and the stay anchor position is 3200 – 500 = 2700mm.

The distance (at ground level) between the stay anchor position and the position vertically below the spar tip is 2700 – 2300 = 400mm.

1. Determine the angle Φ:

$$\Phi = \arctan \frac{400}{9250}$$

$$= 2.5°$$

2. Determine the stay tension:

$$F_{stay} = \frac{F_{tip} \times h_t}{D \cos \Phi}$$

$$F_{stay} = \frac{16 \times 11.7}{2.7 \times \cos 2.5°} = 69.3\text{kN}$$

The stay tension is greater than the maximum design breaking load for a single 19/2.00 stay wire (56.4kN), but less than that for 2 x 19/2.00 (112kN).

Using the ground stay selection guide, we determine the screw anchor size. Because the anchor is to be installed in good soil, a single 200mm screw anchor would be appropriate. Assuming class 3 soil, we can achieve a strength of 76kN, installing with a torque of 5600N.m or 6 shear pins.

SCREW ANCHOR STRENGTH AND MINIMUM INSTALLATION TORQUE

No. OF BLADES	BLADE DIAMETER	TYP. USE	ELEMENT	GOOD SOIL		AVERAGE SOIL		POOR SOIL	
				2	3	4	5	6	7
1 SINGLE	200mm	GOOD SOIL	Strength (kN)	92	76	64	48	36	20
			Install Torque (N.m)	7600	5600	3700	2300	1300	400
			No. Shear Pins	8	6	4	3	3	
	250mm	AV. SOIL	Strength (kN)	-	84	68	56	40	24
			Install Torque (N.m)	-	6100	4200	2500	1500	600
			No. Shear Pins	-	7	6	5	3	
	300mm	POOR WET SOIL	Strength (kN)	-	92	76	64	48	32
			Install Torque (N.m)	-	6800	4400	3100	1750	800
			No. Shear Pins	-	7	5	4	3	
2 DOUBLE	200mm	POOR DRY SOIL	Strength (kN)	-	-	96	76	56	36
			Install Torque (N.m)	-	-	5700	3800	2200	1800
			No. Shear Pins	-	-	6	4	3	
	250mm	POOR DRY SOIL	Strength (kN)	-	-	108	88	68	48
			Install Torque (N.m)	-	-	6000	4100	2500	900
			No. Shear Pins	-	-	7	6	3	

Offset Stay from Ideal Position

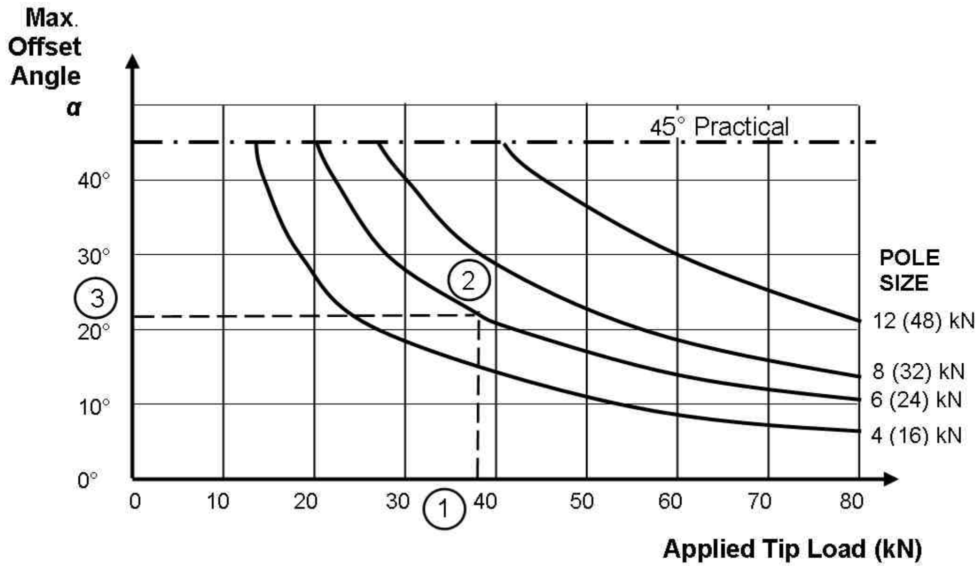
A ground stay for a 6kN pole must be offset to avoid a culvert. The pole has a maximum wind tip load of 38kN. What is the maximum offset angle acceptable?

Using the stay offset angle chart plot the 38kN tip load (point 1 on the horizontal axis).

Trace a vertical to the 6kN curve (point 2).

Trace horizontally to the vertical axis (point 3 on the max offset angle axis).

The maximum offset angle for this example is 22°.


Max.
Offset
Angle
α
45° Practical
40°
30°
3
20°
10°
0°
2
POLE
SIZE
12 (48) kN
8 (32) kN
6 (24) kN
4 (16) kN
0
10
20
30
1
40
50
60
70
80
Applied Tip Load (kN)

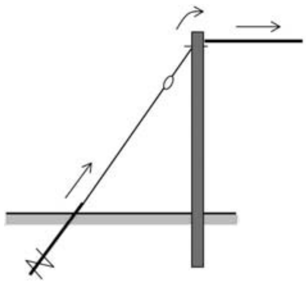
10.6 Engineering notes

Load case

Generally it is only necessary to consider the Maximum Wind load case when selecting and sizing stays. Given Conductor Loads due to design tensions.

Stay sizing

For distribution applications, ensure that the stay is designed to take the full load applied and not just the portion by which the load exceeds pole capacity. Do not assume that the pole and stay share load, since the pole tip will flex under load, whereas the stay anchor is rigid and will immediately be subjected to the full load.



Pole sizing

The question frequently arises as to what pole strength to select when the pole will need to be stayed. Use of an unstayed heavy pole is preferable to a light pole that is stayed. Where a stay cannot be avoided, a minimum size 8kN (32kN ultimate) pole shall be used with the additional requirement that the pole and foundation shall be capable of withstanding the Failure Containment Load detailed in Clause 5.2 (Note: Failure Containment Load should be applied with all phase conductors assumed to be intact instead of two thirds broken). This policy ensures that the pole will not collapse in the event of stay component failure in moderate weather conditions.

The 8kN minimum pole size ensures that the pole will not buckle under the additional pressure of vertical loads applied by the stay wire through the longitudinal axis of the pole.

Stay angle selection

A stay angle to the ground of 45° is recommended.

However, where space it is limited, designers may increase the ground angle, bringing the stay anchor closer to the pole, with a maximum recommended angle of 60°. This will increase tension in the stay wire and increase downward compressive forces on the pole and its foundation.

While reducing the ground angle below 45° reduces stay tension, it creates practical difficulties in terms of stay anchor installation. The stay anchor rod should be in line with the stay wire; otherwise there will be a tendency for the rod to bend and the galvanised coating may be compromised.

Construction stays

Designers may find it necessary to alert construction crews to the need for temporary stays on strain poles while construction is in progress, prior to all conductors being erected and correctly tensioned.

Stay location selection

Where practicable ground stays should not be used in frequented areas such as public roadside footpaths, bicycle ways, horse riding areas or livestock forcing areas near stock yard access ways. Where used in unfrequented areas, cattle fence barriers need be positioned to protect ground stay from large animal rubbing reliability problems.

Permanent Ground Stay Anchor metalwork needs to be positioned to avoid corrosion by ground level soil coverage of the galvanised steel stay wire and its galvanised steel termination fittings.

Use of ground stays in flash-flood prone areas should be avoided in places where flood debris can accumulate on the flooded stay enhancing water wake footing erosion and drag loading.

11.0 POLETOP CONSTRUCTIONS

11.1 Application guide

Clause 11.3 lists nominal maximum span lengths and deviation angles for various Ausgrid poletop construction and conductor combinations. This enables designers to select a suitable construction for each pole in the line under consideration. [3] The data presented in the table takes into account factors such as component strengths and conductor clashing, but does not take into account ground clearance or pole tip load limitations.

Clause 7.1 discusses conductor selection and when insulated mains should be used.

Apart from spanning and angular limitations, constructions should be selected taking into account:

- whole-of-life cost
- reliability
- suitability for environment - vegetation, wildlife, salt and industrial pollution levels
- visual impact
- ease of construction and maintenance.

Flat (horizontal) construction has the advantage of requiring minimal pole height, but at the expense of greater overall overhead line and easement width. Timber crossarms have the drawback of being prone to rot and weathering, leading to in-service failure.

Some steel crossarm choices are available for strength needs in design.

Field Trials of fibreglass crossarms still under way.

Flat constructions are preferred for spans in areas frequented by aquatic birds. For higher frequency risk spans, increased horizontal conductor separation can reduce bird impact conductor flashover, and bird diverters can be added to conductors to provide more effective visual warning to birds in flight.

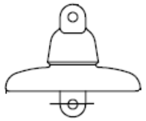
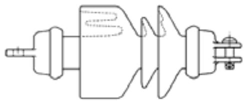
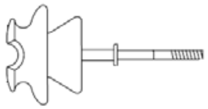
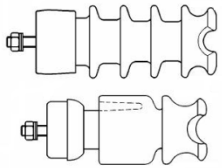
Vertical construction is excellent for narrow easements or to reduce vegetation clearing, but requires additional pole height.

Vertical Delta or Delta Pin construction provides both horizontal and vertical separation between phases, which helps reduce the incidence of conductor clashing.

Generally speaking, the more compact a poletop construction is, the less visually obtrusive it is, although reduced phase separation means reduce spanning capability. Designers should aim to keep constructions reasonably consistent along a line. Not only is this more visually pleasing, but rolling from one style to another can reduce spanning capability and cause confusion with phasing.

[3] These are provided for general guidance, but may be exceeded where the designer can demonstrate compliance with Ausgrid design principles by means of engineering calculations or outputs from recognized line design software.

11.2 Insulator selection

HV Insulator Type		Usage within Ausgrid Distribution Network	Remarks
	**Longrod Composite**	• Suspension constructions for bare conductor • Termination and Through Termination constructions for bare conductor (Railway Crossings excepted)	• Preferred over standard ceramic or glass disk for most applications, since lightweight, inexpensive and non-puncturable • Can be susceptible to damage by birds such as cockatoos and galahs
	**Ceramic or Glass Disk**	• Railway Crossing through Termination constructions	• Conventional technology with proven service life • Heavy, puncturable (so always use. min. of 2 disks), susceptible to pin corrosion and vandalism • Additional disks can easily be added in areas of high pollution (salt or industrial) or fog • Each disk has creepage path of ~300mm. Typically need 16 – 31mm per kilovolt (L-G) depending upon pollution level.
	**Ceramic Strain Rod**	• Termination or Through Termination constructions for CCT	• Used in conjunction with strain clamp and cover • Superior performance to standard ceramic disk, similar to fog insulator with extended creepage length
	**Pin (Ceramic)**	• Standard Horizontal and Delta Pin constructions for bare conductor	• Inexpensive • For mounting on crossarm or riser bracket • Not suitable for use with CCT - field strength too great due to comparatively short length
	**Post (Ceramic)**	• Intermediate constructions for CCT • Support for Bridging on Vertical Through Termination constructions	• For mounting on gain base • Superior electrical performance to pin but more expensive

Insulator selection is very straightforward for distribution voltages. However, for higher voltages, electrical performance (pollution performance, power frequency flashover, lightning and switching surge flashover) requires careful analysis and weighing against costs.

11.3 Span and angle limits of Constructions

11.3.1 LV bare conductor constructions

CONSTRUCTION		SLACK 2% UTS		URBAN 6% UTS		SEMI-URBAN 12% UTS				RURAL (see Note 2) 20% UTS – AAC 22. 5% UTS – ACSR			
No.	Description	MERCURY	PLUTO	MERCURY	PLUTO	MERCURY	PLUTO	APPLE	CHERRY	MERCURY	PLUTO	APPLE	CHERRY
1-1	Flat Pin	49m	49m	86m	86m	110m	109m	135m	131m	170m	170m		
		50°/30m	50°/30m	20°/80m	20°/80m	5°/109m	5°/108m	15°/130m	5°/130m	5°/169m	5°/169m		
1-2	Offset Pin												
1-3	Angle												
1-10 1-12 1-14	Termination Corner Tee-off												
1-11	Through Termination												

Maximum Span Length
Maximum Deviation Angle

Notes:

1. Span and angle limitations reflect strength limitations of components, clearance limitations and avoidance of mid-span clashing. Maximum deviation angles are listed in conjunction with nominal maximum span lengths. Designers still need to take into account other limitations such as ground clearance and tip loads on poles.
2. Assumes vibration protection installed on tight-strung lines or other locations susceptible to aeolian vibration.
3. Standard crossarm sizes and geometry is assumed.
4. Assumes crossarm mounted to split line deviation angle.

11.3.2 LVABC constructions

CONSTRUCTION		SLACK 2% UTS		URBAN 6. 0% UTS		SEMI-URBAN 10% UTS	
No.	Description	95mm2	150mm2	95mm2	150mm2	95mm2	150mm2
1-70	Intermediate						
1-73	Intermediate Angle						
1-71 1-76 1-77	Termination Tee-off						
1-74	Through Termination						

Maximum Span Length
Maximum Deviation Angle

Notes:

1. Span and angle limitations reflect strength limitations of components and clearance limitations.
Designers still need to take into account other limitations such as ground clearance and tip loads on poles.

11.3.3 11kV bare conductor constructions

	CONSTRUCTION	SLACK 2% UTS		URBAN 6. 0% UTS		SEMI-URBAN 12% UTS				RURAL (see Note 3) 20% UTS – AAC 22. 5% UTS – ACSR			
No.	Description	MERCURY	PLUTO	MERCURY	PLUTO	MERCURY	PLUTO	APPLE	CHERRY	MERCURY	PLUTO	APPLE	CHERRY
2-1	Flat Pin (see Note 2)												
2-2	Offset Pin												
2-3	Suspension (see Note 2)												
2-4	¾ Offset Pin												
2-5	Small Delta Pin												
2-6	Delta Pin												
2-7	Large Delta Pin												
2-10 2-12 2-14	Termination Corner Tee-off												
2-11	Through Termination												
2-23	Railway Termination												
2-30	Large Through Delta Termination												
2-31 2-37 2-38	Large Delta Corner Tee-off												
2-140	Vertical Termination												

Maximum Span Length
Maximum Deviation Angle

Notes:
1. Span and angle limitations reflect strength limitations of components, clearance limitations and avoidance of mid-span clashing. Designers still need to take into account other limitations such as ground clearance and tip loads on poles.
2. Assumes 'staggering' of centre-phase conductor on flat pin construction. Where this is not the case, reduce max. allowable span length by 40%.
3. Assumes vibration protection installed on tight-strung lines or other locations susceptible to aeolian vibration.
4. Standard crossarm sizes and geometry is assumed.

11.3.4 11kV CCT constructions

CONSTRUCTION		SLACK 2% UTS			URBAN 6% UTS			SEMI-URBAN 10% UTS		
No.	Description	80mm2	120mm2	180mm2	80mm2	120mm2	180mm2	80mm2	120mm2	180mm2
2-200CCT	Delta Pin Post									
2-240	Vertical Pin Post									
2-1CCT	Flat Pin (see Note 2)									
2-2CCT	Offset Flat Pin									
2-4CCT	¾ Offset Flat Pin									
2-5CCT	Small Delta Pin									
2-6CCT	Delta Pin									
2-7CCT	Large Delta Pin									
2-10CCT, 2-14CCT	Termination, Tee-off									
2-11CCT	Through Termination									
2-30CCT	Large Through Delta Termination									
2-38CCT	Large Delta Tee-off									
2-140CCT, 2-142CCT	Vertical Termination, Vertical 4-way Termination									
2-146CCT	Vertical Through Termination									

Maximum Span Length
Maximum Deviation Angle

Notes:

1. Span and angle limitations reflect strength limitations of components, clearance limitations and avoidance of mid-span clashing. Designers still need to take into account other limitations such as ground clearance and tip loads on poles.
2. Assumes 'staggering' of centre-phase conductor on flat pin construction. Where this is not the case, reduce max. allowable span length by 40%.

11.3.5 22kV bare conductor constructions

CONSTRUCTION		SLACK 2% UTS		URBAN 6. 0% UTS		SEMI-URBAN 12% UTS				RURAL (see Note 3) 20% UTS – AAC 22. 5% UTS – ACSR			
No.	Description	MERCURY	PLUTO	MERCURY	PLUTO	MERCURY	PLUTO	APPLE	CHERRY	MERCURY	PLUTO	APPLE	CHERRY
3-1	Flat Pin (see Note 2)												
3-2	Small Delta Pin												
3-10	Termination												
3-11	Through Termination												
3-140	Vertical Termination												
3-200	Vertical Delta												
3-240	Vertical Post												

Maximum Span Length
Maximum Deviation Angle

Notes:

1. Span and angle limitations reflect strength limitations of components, clearance limitations and avoidance of mid-span clashing. Designers still need to take into account other limitations such as ground clearance and tip loads on poles.
2. Assumes ‘staggering’ of centre-phase conductor on flat pin construction. Where this is not the case, reduce max. allowable span length by 40%.
3. Assumes vibration protection installed on tight-strung lines or other locations susceptible to aeolian vibration.
4. Standard crossarm sizes and geometry is assumed.

11.3.6 SWER constructions

CONSTRUCTION		SLACK 2% UTS		URBAN 6. 0% UTS		SEMI-URBAN 12% UTS				RURAL (see Note 2) 20% UTS – AAC 22. 5% UTS – ACSR			
No.	Description	MERCURY	PLUTO	MERCURY	PLUTO	MERCURY	PLUTO	APPLE	CHERRY	MERCURY	PLUTO	APPLE	CHERRY
3-1	Pin												
3-2	'Flying' Angle												
3-10	Termination												
3-11	Through Termination												

Maximum Span Length
Maximum Deviation Angle

Notes:

1. Span and angle limitations reflect strength limitations of components, clearance limitations and avoidance of mid-span clashing. Designers still need to take into account other limitations such as ground clearance and tip loads on poles.
2. Assumes vibration protection installed on tight-strung lines or other locations susceptible to aeolian vibration.

11.4 Phasing

under development

11.5 Bridging

under development

11.6 Pole-mounted plant

11.6.1 Transformers

Site requirements

Transformers should be positioned on reasonably straight sections of line with good access and moderate span lengths on either side where practicable.

Do not locate:

- in an area with poor vehicular access
- within 3m of a concrete driveway, if possible
- within an overhead or underground transmission line easement
- on a steep slope or adjacent to a steep downhill slope of more than 10% grade, or where ladder access is difficult
- in unstable soils
- in reclaimed land-fill sites, wetlands or similar locations
- within a flood-prone area, drainage path or storm-water ponding area
- where ground water is likely to be found within 1m of the surface
- within 5m upstream of a storm water gully trap where there is less than 500mm of space between the pole and the kerb (so that no oil can discharge into waterways)
- within 40m upstream of a waterway or sensitive environment such as a wetland, national park or nature reserve
- where it will be particularly visually obtrusive
- where exposure to electro-magnetic fields is likely to be an issue
- where good earthing is difficult to obtain or in close proximity to telecommunications equipment
- within high bushfire risk areas.

Pole requirements

Substations may be constructed on existing 12.5m poles of 8kN or 12kN working strength (i.e. 32kN or 48kN ultimate strength) providing the pole is assessed as being in good condition and having a long life expectancy. (This assessment is to be carried out by an accredited pole inspector and the reduction in pole diameter near ground line should be < 10%. However, the design approach shall be in accordance with Clause 9.7.1)

For new sites, 14m poles are preferred. For longer poles, ensure that equipment mounting heights are not more than would be used for a 14m pole.

The transformer mounting bracket is designed for pole diameters in the range 300 - 360mm at a distance of 8.45m from the butt.

Orientation

The transformer shall be oriented so as to be aligned for correct phasing. Where possible, climbing access shall be on the side opposite the direction of traffic flow. (Refer Clause 11.4)

Indicative Vertical Spacings

Plant Type		1 phase Up to 63kV. A	3 phase Up to 400kV. A	
Pole Length		12. 5m	14m	12. 5m
Pole Strength (Working)		8kN	8kN or 12kN	8kN or 12kN
Pole Sinking Depth (Concrete Foundation)		2. 25m	2. 40m	2. 25m
Distance Below Tip	HV Circuit	0. 2m	0. 2m	0. 2m
	HV Fuses	1. 4m	1. 4m	1. 1m
	LV Circuit	2. 4m	3. 2m	2. 9m
	Transformer Mount	1. 85m	4. 5m	4. 05m

Weight and Windage of Transformers 100kVA and Above

Primary Voltage	Capacity	Approximate Weight See Note 1	Approximate Effective Area		Approximate Equivalent Tip Load See Note 2	
			Face	Side	Face	Side
11kV	100kV. A	765kg	0. 89m2	0. 54m2	1. 23kN	0. 75kN
	200kV. A	1055kg	1. 03m2	0. 62m2	1. 42kN	0. 86kN
	400kV. A	1700kg	1. 22m2	0. 74m2	1. 68kN	1. 02kN

Notes:

1. Transformer weight has only a small effect on the overturning moment or tip load of the pole as the centre of mass is only a short distance from the pole axis.
2. The values shown in the table assume a wind normal to either the face or the side of the pole, exerting a force of 2300Pa to the surface. The centre of pressure is assumed to be at 60% of the pole tip height. If in doubt as to the worst case wind direction, use the Face value for a transformer at the end of a HV line, but the Side value where the HV line extends both directions from the transformer.
3. The effect of mining lease open cut mine air blast pressure wave can be up to 100mm /sec or higher in special cases, and it is not allowed for in standard maximum wind design. A separate design assessment is appropriate case by case.

Refer to NS122 for other Requirements

Transformers of 100kV. A and above shall be fitted with MDIs, except where the substation supplies a single consumer.

Where installing a new pole substation into an existing LV open-wire line, the LV open-wire construction shall be recovered to the next pole and replaced with ABC mains.

Service connections are not permitted on substation poles except where there are no reasonable alternatives. A new private pole or mid-span service (LVABC mains only) must be installed where this would avoid a service emanating from the substation pole.

For example, a single supply from a substation in a rural area is allowed.

11.7 Fittings and hardware

under development

A future reference will be - Ausgrid Network Standard Overhead Constructions – Accessories, Volume 3.

11.8 Worked examples

under development

11.9 Engineering notes

11.9.1 Derivation of poletop construction limits tables

The maximum span lengths and deviation angles presented for the various poletop constructions in Clause 11.3 take into account factors such as:

- strength limitations of crossarms, braces, insulators, bolts, conductor ties, clamps and other fittings
- avoidance of mid-span clashing between the conductor phases
- avoidance of clearance issues, e.g. insulator or conductor clearance from crossarm or pole on heavy angles
- maintenance loads and construction loads
- broken wire conditions.

(Note that designers still need to verify that there are adequate ground and intercircuit clearances.)

Forces on components increase with increasing wind and weight span, deviation angle, conductor size and stringing tension. Strength factors for various classes of component are tabulated in Clause 5.4.

Note that the tables in Clause 11.3 aim to strike a balance between span and angle limitations, as there is a trade-off between these two parameters.

Conductor clashing

In general, to avoid clashing between conductors, the following condition must be met:

$$\sqrt{(X^2 + 1.2Y^2} \geq U / 150 + k\sqrt{D + l_i}$$

X is the horizontal distance between the conductors at mid-span (m)

Y is the vertical distance between the conductors at mid-span (m)

U is the rms difference in potential between the two conductors (kV)

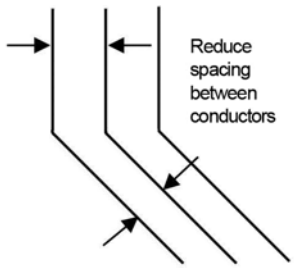
D is the greater of the two conductor sags (m) – No Wind, 50°C

l_i is the length of any freely swinging suspension insulator with either conductor (m)

k is an empirical factor, generally taken to be 0.4, but which can be increased for added reliability for critical lines or spans, e.g. to 0.6[4]

Larger spacing between conductors at supports reduces the likelihood of conductor clashing.

The probability of mid-span clashing also increases as conductor sag increases. Sag increases with span length, but decreases with increased stringing tension, so tighter stringing enables greater distances to be spanned. Also, as deviation angle increases, there is a reduction of spacing between phase conductors, as illustrated right.

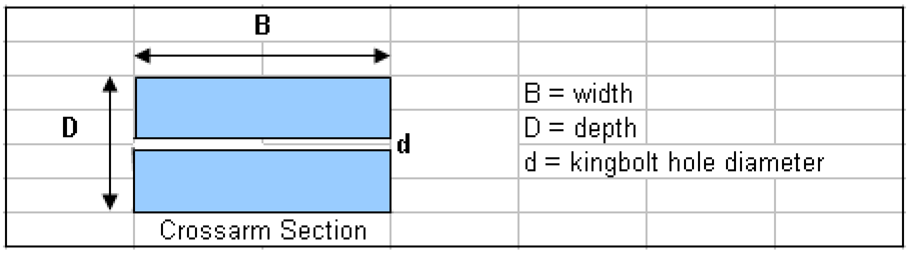


[4] Use of other values of *k* should only be undertaken in consultation with experts from the Ausgrid Overhead Mains group.

11.9.2 Timber crossarm strength

A crossarm acts as a beam, supported at the king bolt through the pole(s), and at a secondary point when a brace is used. The crossarm must be capable of supporting the vertical, transverse and longitudinal loads to which it is to be subjected under normal and extreme situations, such as when one wire is broken. The vertical case should also cater for the addition of a 100kg worker.

The applied bending moment produces stresses within the wood, with the maximum fibre stresses occurring at the points furthest from the neutral axis, i.e. at the outer edges. The forces are compressive on the side in the direction of the load and tensile on the opposite side.



The fibre stress at any cross-section is:

$f = M / z$

where:

f	fibre stress (bending)	- 67MPa for seasoned S2 timber - 42MPa for unseasoned S2 timber
M	bending moment (force-distance product) applied to crossarm (N.m)	
z	section modulus of crossarm (m^3)	

and

$z = (D-d)B^2/6$ (Longitudinal)
$= B(D^3-d^3)/6D$ (Vertical)

The maximum permissible bending moment (design capacity) for a crossarm is:

$M = f z \varphi$

where

φ strength factor (see Clause 5.4)

Notes:

1. All designs should allow for Strength Group = S2
2. Within Ausgrid, common distribution crossarm depth is 100mm, and widths of 100mm and 150mm are available. Common lengths are 2100mm and 2700mm.
3. For seasoned timber arms, depth = 90mm and widths = 90mm and 140mm.
4. A timber arm may be regarded as seasoned where:
   - The arm has been in service for more than five years
   - the site is more than 10km from the coast

11.9.3 Composite fibre crossarm strengths

Design capacities of composite fibre arms are dependent on construction methodology and test results and are therefore proprietary. Ultimate capacities of composite fibre arms designed and tested by Wagners – Composite Fibre Technologies (or equivalent) and suitable for use in Ausgrid are provided below:

Crossarm Type	Ultimate Moment (kN-m)	Ultimate Capacity (kN)
2750x125x125 LV Strain	33.8	18.1
3030x100x100 HV Intermediate	17.7	11.0
3030x125x125 HV Strain	33.8	23.3

11.9.4 Insulator swing and structure clearance

<under development – see reference 23 Clause 6.8 and Annexure R>

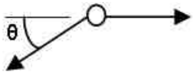
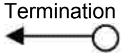
11.9.5 Lightning protection

<under development – see NS126 Annexure A>

12.0 MECHANICAL LOADS

12.1 Conductor load tables

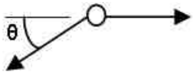
12.1.1 MERCURY 7/4. 50 AAC

Deviation Angle	Stringing Tension	SLACK 2% UTS			URBAN 6% UTS			SEMI-URBAN 12% UTS			RURAL 20% UTS		
 θ	Assumed Span Length (see Note 5)	30m			80m			130m			180m		
	Load Condition	Sustained 5ºC	Max. Wind 15ºC Urban 900Pa	Max. Wind 15ºC Rural 966Pa	Sustained 5ºC	Max. Wind 15ºC Urban 900Pa	Max. Wind 15ºC Rural 966Pa	Sustained 5ºC	Max. Wind 15ºC Urban 900Pa	Max. Wind 15ºC Rural 966Pa	Sustained 5ºC	Max. Wind 15ºC Urban 900Pa	Max. Wind 15ºC Rural 966Pa
0º		0. 00	0. 31	0. 33	0. 00	0. 92	0. 99	0. 00	1. 62	1. 74	0. 00	2. 18	2. 34
5º		0. 03	0. 55	0. 59	0. 10	1. 42	1. 52	0. 19	2. 24	2. 40	0. 32	3. 20	3. 44
10º		0. 06	0. 69	0. 74	0. 19	1. 83	1. 95	0. 40	3. 05	3. 25	0. 63	4. 26	4. 53
15º		0. 10	0. 83	0. 89	0. 29	2. 23	2. 38	0. 57	3. 67	3. 90	0. 95	5. 29	5. 61
20º		0. 13	0. 97	1. 04	0. 39	2. 63	2. 80	0. 79	4. 49	4. 77	1. 26	6. 31	6. 68
25º		0. 16	1. 11	1. 19	0. 48	3. 02	3. 22	0. 94	5. 06	5. 37	1. 57	7. 32	7. 74
30º		0. 19	1. 25	1. 33	0. 57	3. 41	3. 63	1. 16	5. 88	6. 24	1. 88	8. 31	8. 79
35º		0. 22	1. 38	1. 47	0. 67	3. 79	4. 04	1. 33	6. 51	6. 90	2. 18	9. 29	9. 81
40º		0. 25	1. 51	1. 61	0. 76	4. 16	4. 44	1. 52	7. 18	7. 62	2. 48	10. 25	10. 83
45º		0. 28	1. 64	1. 75	0. 85	4. 53	4. 82	1. 70	7. 86	8. 33	2. 78	11. 19	11. 82
50º		0. 31	1. 77	1. 89	0. 94	4. 89	5. 20	1. 88	8. 48	8. 99	3. 07	12. 11	12. 78
55º		0. 34	1. 89	2. 01	1. 02	5. 23	5. 57	2. 06	9. 16	9. 71	3. 35	13. 01	13. 72
60º		0. 37	2. 00	2. 14	1. 11	5. 57	5. 93	2. 23	9. 75	10. 33	3. 63	13. 88	14. 64
65º		0. 40	2. 12	2. 26	1. 19	5. 90	6. 28	2. 38	10. 29	10. 90	3. 90	14. 72	15. 53
70º		0. 42	2. 23	2. 38	1. 27	6. 22	6. 62	2. 55	10. 91	11. 56	4. 16	15. 54	16. 39
75º		0. 45	2. 34	2. 49	1. 35	6. 52	6. 94	2. 62	10. 81	11. 45	4. 42	16. 33	17. 22
80º		0. 47	2. 44	2. 60	1. 43	6. 81	7. 25	2. 75	11. 15	11. 80	4. 66	17. 09	18. 01
85º		0. 50	2. 53	2. 71	1. 50	7. 09	7. 55	2. 87	11. 48	12. 15	4. 90	17. 81	18. 78
90º		0. 52	2. 63	2. 80	1. 57	7. 36	7. 83	3. 00	11. 83	12. 53	5. 13	18. 50	19. 50
Termination 		0. 33	1. 34	1. 43	1. 11	4. 72	5. 02	2. 22	8. 45	8. 93	3. 62	12. 02	12. 65

Notes:

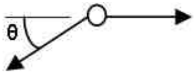
1. Loads are in kilonewtons (kN), are per Conductor, and in the horizontal plane (essentially).
2. Stringing tensions in %UTS are at standard temperature of 5ºC.
3. Loads include load factors of 1. 1 for the everyday limit state (sustained or no wind condition) and 1. 25 for the ultimate strength limit state (maximum wind condition).
4. Loads have been calculated with TL-Pro, which does not check for worst case wind direction. Some discrepancies may be evident with hand calculations or other software at large deviation angles. Rural wind pressure incorporates nominal SRF as per Clause 5. 2.
5. The values tabulated will cover the majority of situations. However, if span length is significantly larger than assumed span length shown or if the area is prone to microbursts, a full calculation should be carried out or design software used.

12.1.2 PLUTO 19/3. 75 AAC

Deviation Angle	Stringing Tension	SLACK 2% UTS			URBAN 6% UTS			SEMI-URBAN 12% UTS			RURAL 20% UTS		
	Assumed Span Length (see Note 5)	30m			80m			130m			180m		
	Load Condition	Sustained 5ºC	Max. Wind 15ºC Urban 900Pa	Max. Wind 15ºC Rural 966Pa	Sustained 5ºC	Max. Wind 15ºC Urban 900Pa	Max. Wind 15ºC Rural 966Pa	Sustained 5ºC	Max. Wind 15ºC Urban 900Pa	Max. Wind 15ºC Rural 966Pa	Sustained 5ºC	Max. Wind 15ºC Urban 900Pa	Max. Wind 15ºC Rural 966Pa
0º		0. 00	0. 54	0. 58	0. 00	1. 39	1. 49	0. 00	2. 24	2. 40	0. 00	3. 02	3. 24
5º		0. 06	0. 75	0. 80	0. 18	1. 98	2. 11	0. 37	3. 31	3. 54	0. 60	4. 59	4. 89
10º		0. 12	0. 95	1. 01	0. 37	2. 56	2. 74	0. 73	4. 39	4. 67	1. 19	6. 16	6. 54
15º		0. 18	1. 15	1. 23	0. 55	3. 14	3. 35	1. 10	5. 45	5. 80	1. 79	7. 72	8. 17
20º		0. 24	1. 35	1. 44	0. 73	3. 72	3. 96	1. 46	6. 51	6. 91	2. 38	9. 26	9. 80
25º		0. 30	1. 55	1. 65	0. 91	4. 28	4. 56	1. 82	7. 55	8. 01	2. 96	10. 79	11. 40
30º		0. 36	1. 74	1. 86	1. 08	4. 84	5. 16	2. 17	8. 58	9. 09	3. 54	12. 29	12. 98
35º		0. 42	1. 93	2. 06	1. 26	5. 39	5. 74	2. 52	9. 59	10. 16	4. 12	13. 77	14. 53
40º		0. 48	2. 12	2. 26	1. 43	5. 93	6. 31	2. 87	10. 58	11. 21	4. 68	15. 23	16. 06
45º		0. 53	2. 30	2. 45	1. 60	6. 46	6. 87	3. 21	11. 55	12. 24	5. 24	16. 65	17. 56
50º		0. 59	2. 48	2. 65	1. 77	6. 98	7. 42	3. 55	12. 51	13. 24	5. 79	18. 05	19. 02
55º		0. 64	2. 65	2. 83	1. 93	7. 48	7. 95	3. 88	13. 43	14. 22	6. 32	19. 41	20. 45
60º		0. 70	2. 82	3. 01	2. 09	7. 97	8. 47	4. 20	14. 33	15. 17	6. 85	20. 73	21. 84
65º		0. 75	2. 90	3. 19	2. 25	8. 44	8. 98	4. 51	15. 21	16. 09	7. 36	22. 02	23. 19
70º		0. 80	3. 15	3. 35	2. 40	8. 90	9. 46	4. 82	16. 05	16. 99	7. 86	23. 26	24. 49
75º		0. 85	3. 30	3. 52	2. 55	9. 34	9. 93	5. 11	16. 87	17. 85	8. 34	24. 46	25. 75
80º		0. 90	3. 45	3. 67	2. 69	9. 77	10. 38	5. 40	17. 65	18. 68	8. 80	25. 61	26. 96
85º		0. 94	3. 59	3. 82	2. 83	10. 17	10. 81	5. 67	18. 40	19. 46	9. 25	26. 71	28. 12
90º		0. 99	3. 72	3. 96	2. 96	10. 56	11. 21	5. 94	19. 12	20. 22	9. 68	27. 76	29. 22
Termination 		0. 69	2. 36	2. 52	2. 09	6. 79	7. 21	4. 18	12. 43	13. 13	6. 83	18. 15	19. 07

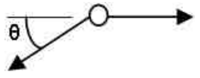
Notes:
1. Loads are in kilonewtons (kN), are per Conductor, and in the horizontal plane (essentially).
2. Stringing tensions in %UTS are at standard temperature of 5ºC.
3. Loads include load factors of 1. 1 for the everyday limit state (sustained or no wind condition) and 1. 25 for the ultimate strength limit state (maximum wind condition).
4. Loads have been calculated with TL-Pro, which does not check for worst case wind direction. Some discrepancies may be evident with hand calculations or other software at large deviation angles. Rural wind pressure incorporates nominal SRF as per Clause 5. 2.
5. The values tabulated will cover the majority of situations. However, if span length is significantly larger than assumed span length shown or if the area is prone to microbursts, a full calculation should be carried out or design software used.

12.1.3 APPLE 6/1/3. 00 ACSR

Deviation Angle	Stringing Tension	SEMI-URBAN 10% UTS			RURAL 22. 5% UTS		
	Assumed Span Length (see Note 5)	130m			230m		
	Load Condition	Sustained 5ºC	Max. Wind 15ºC		Sustained 5ºC	Max. Wind 15ºC	
			Urban 900Pa	Rural 966Pa		Urban 900Pa	Rural 966Pa
0º		0. 00	1. 09	1. 17	0. 00	1. 91	2. 05
5º		0. 17	1. 67	1. 78	0. 32	2. 83	3. 01
10º		0. 34	2. 24	2. 38	0. 64	3. 75	3. 98
15º		0. 51	2. 81	2. 98	0. 96	4. 67	4. 93
20º		0. 68	3. 37	3. 57	1. 28	5. 57	5. 88
25º		0. 85	3. 93	4. 15	1. 60	6. 47	6. 81
30º		1. 02	4. 48	4. 73	1. 91	7. 35	7. 73
35º		1. 18	5. 02	5. 30	2. 22	8. 22	8. 64
40º		1. 34	5. 55	5. 86	2. 52	9. 07	9. 53
45º		1. 50	6. 08	6. 40	2. 82	9. 91	10. 41
50º		1. 66	6. 59	6. 94	3. 12	10. 72	11. 26
55º		1. 81	7. 08	7. 46	3. 40	11. 52	12. 09
60º		1. 97	7. 57	7. 97	3. 69	12. 29	12. 90
65º		2. 11	8. 04	8. 46	3. 96	13. 05	13. 68
70º		2. 25	8. 49	8. 93	4. 23	13. 77	14. 44
75º		2. 39	8. 93	9. 39	4. 49	14. 47	15. 17
80º		2. 53	9. 35	9. 84	4. 74	15. 15	15. 88
85º		2. 66	9. 75	10. 26	4. 98	15. 79	16. 55
90º		2. 78	10. 14	10. 66	5. 21	16. 41	17. 19
Termination 		1. 96	6. 63	6. 96	3. 60	10. 43	10. 91

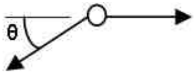
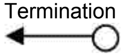
Notes:
1. Loads are in kilonewtons (kN), are per Conductor, and in the horizontal plane (essentially).
2. Stringing tensions in %UTS are at standard temperature of 5ºC.
3. Loads include load factors of 1. 1 for the everyday limit state (sustained or no wind condition) and 1. 25 for the ultimate strength limit state (maximum wind condition.
4. Loads have been calculated with TL-Pro, which does not check for worst case wind direction. Some discrepancies may be evident with hand calculations or other software at large deviation angles. Rural wind pressure incorporates nominal SRF as per Clause 5. 2.
5. The values tabulated will cover the majority of situations. However, if span length is significantly larger than assumed span length shown or if the area is prone to microbursts, a full calculation should be carried out or design software used.

12.1.4 Cherry 6/4. 75 + 7/1. 60 ACSR

Deviation Angle	Stringing Tension	SEMI-URBAN 10% UTS			RURAL 22. 5% UTS		
	Assumed Span Length (see Note 5)	130m			230m		
	Load Condition	Sustained 5ºC	Max. Wind 15ºC		Sustained 5ºC	Max. Wind 15ºC	
			Urban 900Pa	Rural 966Pa		Urban 900Pa	Rural 966Pa
0º		0. 00	1. 71	1. 84	0. 00	3. 00	3. 22
5º		0. 38	2. 72	2. 89	0. 72	4. 66	4. 96
10º		0. 77	3. 72	3. 94	1. 44	6. 32	6. 68
15º		1. 15	4. 72	4. 99	2. 16	7. 96	8. 40
20º		1. 53	5. 70	6. 02	2. 87	9. 59	10. 10
25º		1. 91	6. 68	7. 04	3. 58	11. 20	11. 78
30º		2. 28	7. 64	8. 05	4. 28	12. 79	13. 43
35º		2. 65	8. 59	9. 05	4. 97	14. 35	15. 07
40º		3. 01	9. 52	10. 03	5. 65	15. 89	16. 67
45º		3. 37	10. 44	10. 98	6. 32	17. 40	18. 24
50º		3. 72	11. 33	11. 92	6. 98	18. 87	19. 78
55º		4. 07	12. 20	12. 84	7. 63	20. 31	21. 28
60º		4. 40	13. 05	13. 73	8. 26	21. 71	22. 74
65º		4. 73	13. 88	14. 59	8. 88	23. 07	24. 15
70º		5. 05	14. 68	15. 43	9. 48	24. 38	25. 52
75º		5. 36	15. 45	16. 24	10. 06	25. 65	26. 84
80º		5. 66	16. 19	17. 01	10. 62	26. 87	28. 11
85º		5. 95	16. 90	17. 76	11. 16	28. 04	29. 33
90º		6. 23	17. 58	18. 47	11. 68	29. 16	30. 49
Termination 		4. 39	11. 59	12. 16	8. 06	18. 72	19. 54

Notes:
1. Loads are in kilonewtons (kN), are per Conductor, and in the horizontal plane (essentially).
2. Stringing tensions in %UTS are at standard temperature of 5ºC.
3. Loads include load factors of 1. 1 for the everyday limit state (sustained or no wind condition) and 1. 25 for the ultimate strength limit state (maximum wind condition).
4. Loads have been calculated with TL-Pro, which does not check for worst case wind direction. Some discrepancies may be evident with hand calculations or other software at large deviation angles. Rural wind pressure incorporates nominal SRF as per Clause 5. 2.
5. The values tabulated will cover the majority of situations. However, if span length is significantly larger than assumed span length shown or if the area is prone to microbursts, a full calculation should be carried out or design software used.

12.1.5 LVABC 4C 95mm^2

Deviation Angle 	Stringing Tension	SLACK 2% UTS			URBAN 6% UTS			SEMI-URBAN 10% UTS		
	Assumed Span Length (see Note 5)	30m			80m			100m		
	Load Condition	Sustained 5ºC	Max. Wind 15ºC		Sustained 5ºC	Max. Wind 15ºC		Sustained 5ºC	Max. Wind 15ºC	
			Urban 900Pa	Rural 966Pa		Urban 900Pa	Rural 966Pa		Urban 900Pa	Rural 966Pa
0º		0. 00	0. 99	1. 07	0. 00	2. 62	2. 82	0. 00	3. 27	3. 51
5º		0. 10	1. 30	1. 39	0. 30	3. 52	3. 77	0. 51	4. 69	5. 01
10º		0. 20	1. 60	1. 71	0. 61	4. 42	4. 72	1. 01	6. 11	6. 51
15º		0. 30	1. 91	2. 04	0. 91	5. 30	5. 66	1. 52	7. 51	8. 00
20º		0. 40	2. 20	2. 35	1. 21	6. 18	6. 59	2. 02	8. 90	9. 47
25º		0. 50	2. 50	2. 67	1. 50	7. 04	7. 51	2. 52	10. 28	10. 92
30º		0. 60	2. 79	2. 97	1. 80	7. 90	8. 41	3. 01	11. 63	12. 35
35º		0. 69	3. 07	3. 27	2. 09	8. 73	9. 30	3. 50	12. 96	13. 76
40º		0. 79	3. 35	3. 57	2. 38	9. 55	10. 17	3. 98	14. 27	15. 15
45º		0. 88	3. 62	3. 86	2. 66	10. 36	11. 02	4. 46	15. 55	16. 50
50º		0. 98	3. 89	4. 14	2. 94	11. 14	11. 85	4. 92	16. 81	17. 82
55º		1. 07	4. 14	4. 41	3. 21	11. 90	12. 66	5. 38	18. 02	19. 11
60º		1. 16	4. 39	4. 68	3. 46	12. 64	13. 44	5. 82	19. 21	20. 36
65º		1. 24	4. 63	4. 94	3. 74	13. 35	14. 20	6. 26	20. 35	21. 58
70º		1. 32	4. 87	5. 18	3. 99	14. 04	14. 93	6. 68	21. 46	22. 75
75º		1. 41	5. 09	5. 42	4. 23	14. 71	15. 63	7. 09	22. 53	23. 88
80º		1. 49	5. 30	5. 65	4. 47	15. 34	16. 30	7. 49	23. 56	24. 96
85º		1. 56	5. 51	5. 86	4. 70	15. 94	16. 95	7. 87	24. 54	26. 00
90º		1. 63	5. 70	6. 07	4. 92	16. 52	17. 56	8. 24	25. 48	26. 99
Termination 		1. 15	3. 55	3. 78	3. 46	10. 43	11. 07	5. 80	16. 43	17. 38

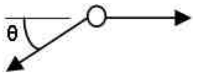
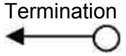
Notes:
1. Loads are in kilonewtons (kN), apply to the entire bundled cable, and are in the horizontal plane (essentially).
2. Stringing tensions in %UTS are at standard temperature of 5ºC.
3. Loads include load factors of 1. 1 for the everyday limit state (sustained or no wind condition) and 1. 25 for the ultimate strength limit state (maximum wind condition).
4. Loads have been calculated with TL-Pro, which does not check for worst case wind direction. Some discrepancies may be evident with hand calculations or other software at large deviation angles. Rural wind pressure incorporates nominal SRF as per Clause 5. 2.
5. The values tabulated will cover the majority of situations. However, if span length is significantly larger than assumed span length shown or if the area is prone to microbursts, a full calculation should be carried out or design software used.

12.1.6 LVABC 4C 150mm^2

Deviation Angle	Stringing Tension	SLACK 2% UTS			URBAN 6% UTS			SEMI-URBAN 10% UTS		
	Assumed Span Length (see Note 5)	30m			80m			100m		
	Load Condition	Sustained 5ºC	Max. Wind 15ºC Urban 900Pa	Max. Wind 15ºC Rural 966Pa	Sustained 5ºC	Max. Wind 15ºC Urban 900Pa	Max. Wind 15ºC Rural 966Pa	Sustained 5ºC	Max. Wind 15ºC Urban 900Pa	Max. Wind 15ºC Rural 966Pa
0º		0. 00	1. 17	1. 26	0. 00	3. 11	3. 34	0. 00	3. 87	4. 16
5º		0. 16	1. 58	1. 69	0. 48	4. 29	4. 59	0. 80	5. 76	6. 15
10º		0. 32	1. 97	2. 11	0. 96	5. 48	5. 84	1. 60	7. 63	8. 12
15º		0. 48	2. 38	2. 53	1. 44	6. 65	7. 08	2. 40	9. 49	10. 08
20º		0. 63	2. 76	2. 94	1. 91	7. 80	8. 30	3. 19	11. 33	12. 02
25º		0. 79	3. 16	3. 36	2. 38	8. 95	9. 51	3. 98	13. 16	13. 94
30º		0. 95	3. 54	3. 76	2. 85	10. 07	10. 70	4. 76	14. 95	15. 83
35º		1. 10	3. 91	4. 16	3. 30	11. 18	11. 87	5. 53	16. 72	17. 70
40º		1. 25	4. 28	4. 55	3. 76	12. 27	13. 02	6. 29	18. 45	19. 53
45º		1. 40	4. 64	4. 92	4. 21	13. 33	14. 14	7. 04	20. 15	21. 31
50º		1. 55	4. 99	5. 30	4. 65	14. 37	15. 24	7. 78	21. 82	23. 07
55º		1. 69	5. 33	5. 66	5. 08	15. 37	16. 30	8. 50	23. 44	24. 77
60º		1. 83	5. 66	6. 01	5. 50	16. 35	17. 34	9. 20	25. 01	26. 44
65º		1. 96	5. 98	6. 35	5. 91	17. 31	18. 34	9. 89	26. 54	28. 05
70º		2. 10	6. 29	6. 67	6. 31	18. 22	19. 31	10. 55	28. 02	29. 60
75º		2. 23	6. 59	6. 99	6. 69	19. 11	20. 24	11. 20	29. 44	31. 10
80º		2. 35	6. 87	7. 29	7. 07	19. 95	21. 14	11. 83	30. 82	32. 55
85º		2. 47	7. 15	7. 58	7. 43	20. 76	21. 99	12. 43	32. 12	33. 92
90º		2. 58	7. 40	7. 85	7. 77	21. 53	22. 80	13. 01	33. 38	35. 24
Termination		1. 82	4. 67	4. 94	5. 47	13. 72	14. 52	9. 17	21. 70	22. 89

Notes:
1. Loads are in kilonewtons (kN), apply to the entire bundled cable, and are in the horizontal plane (essentially).
2. Stringing tensions in %UTS are at standard temperature of 5ºC.
3. Loads include load factors of 1. 1 for the everyday limit state (sustained or no wind condition) and 1. 25 for the ultimate strength limit state (maximum wind condition).
4. Loads have been calculated with TL-Pro, which does not check for worst case wind direction. Some discrepancies may be evident with hand calculations or other software at large deviation angles. Rural wind pressure incorporates nominal SRF as per Clause 5. 2.
5. The values tabulated will cover the majority of situations. However, if span length is significantly larger than assumed span length shown or if the area is prone to microbursts, a full calculation should be carried out or design software used.

12.1.7 CCT 80mm^2

Deviation Angle	Stringing Tension	SLACK 2% UTS			URBAN 6% UTS			SEMI-URBAN 10% UTS		
	Assumed Span Length (see Note 5)	30m			80m			100m		
	Load Condition	Sustained 5ºC	Max. Wind 15ºC Urban 900Pa	Max. Wind 15ºC Rural 966Pa	Sustained 5ºC	Max. Wind 15ºC Urban 900Pa	Max. Wind 15ºC Rural 966Pa	Sustained 5ºC	Max. Wind 15ºC Urban 900Pa	Max. Wind 15ºC Rural 966Pa
0º		0. 00	0. 54	0. 58	0. 00	1. 38	1. 48	0. 00	1. 71	1. 84
5º		0. 03	0. 69	0. 74	0. 10	1. 83	1. 95	0. 17	2. 38	2. 55
10º		0. 07	0. 85	0. 91	0. 20	2. 27	2. 43	0. 34	3. 05	3. 25
15º		0. 10	1. 01	1. 08	0. 30	2. 71	2. 90	0. 50	3. 71	3. 95
20º		0. 13	1. 16	1. 24	0. 40	3. 15	3. 36	0. 67	4. 37	4. 64
25º		0. 17	1. 31	1. 40	0. 50	3. 58	3. 82	0. 83	5. 01	5. 33
30º		0. 20	1. 46	1. 56	0. 60	4. 00	4. 27	1. 00	5. 65	6. 00
35º		0. 23	1. 61	1. 72	0. 69	4. 42	4. 71	1. 16	6. 28	6. 66
40º		0. 26	1. 75	1. 87	0. 79	4. 83	5. 15	1. 32	6. 89	7. 31
45º		0. 29	1. 89	2. 02	0. 88	5. 23	5. 57	1. 48	7. 49	7. 95
50º		0. 32	2. 03	2. 17	0. 97	5. 62	5. 99	1. 63	8. 08	8. 57
55º		0. 35	2. 16	2. 31	1. 06	5. 99	6. 39	1. 78	8. 65	9. 17
60º		0. 38	2. 29	2. 44	1. 15	6. 39	6. 78	1. 93	9. 21	9. 76
65º		0. 41	2. 41	2. 58	1. 24	6. 72	7. 15	2. 07	9. 74	10. 33
70º		0. 44	2. 53	2. 70	1. 32	7. 06	7. 52	2. 21	10. 26	10. 88
75º		0. 47	2. 65	2. 83	1. 40	7. 39	7. 87	2. 35	10. 76	11. 41
80º		0. 49	2. 76	2. 95	1. 48	7. 70	8. 20	2. 48	11. 25	11. 92
85º		0. 52	2. 86	3. 06	1. 56	8. 00	8. 52	2. 60	11. 70	12. 40
90º		0. 54	2. 96	3. 16	1. 63	8. 29	8. 82	2. 73	12. 14	12. 86
Termination 		0. 38	1. 83	1. 96	1. 15	5. 2	5. 53	1. 92	7. 76	8. 21

Notes:

1. Loads are in kilonewtons (kN), are per Conductor, and in the horizontal plane (essentially).
2. Stringing tensions in %UTS are at standard temperature of 5ºC.
3. Loads include load factors of 1. 1 for the everyday limit state (sustained or no wind condition) and 1. 25 for the ultimate strength limit state (maximum wind condition).
4. Loads have been calculated with TL-Pro, which does not check for worst case wind direction. Some discrepancies may be evident with hand calculations or other software at large deviation angles. Rural wind pressure incorporates nominal SRF as per Clause 5. 2.
5. The values tabulated will cover the majority of situations. However, if span length is significantly larger than assumed span length shown or if the area is prone to microbursts, a full calculation should be carried out or design software used.

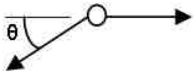
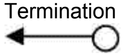
12.1.8 CCT 120mm^2

Deviation Angle	Stringing Tension	SLACK 2% UTS			URBAN 6% UTS			SEMI-URBAN 10% UTS		
	Assumed Span Length (see Note 5)	30m			80m			100m		
	Load Condition	Sustained 5ºC	Max. Wind 15ºC		Sustained 5ºC	Max. Wind 15ºC		Sustained 5ºC	Max. Wind 15ºC	
			Urban 900Pa	Rural 966Pa		Urban 900Pa	Rural 966Pa		Urban 900Pa	Rural 966Pa
0º		0. 00	0. 61	0. 66	0. 00	1. 59	1. 71	0. 00	1. 98	2. 12
5º		0. 05	0. 82	0. 87	0. 15	2. 16	2. 32	0. 26	2. 84	3. 03
10º		0. 10	1. 01	1. 09	0. 31	2. 73	2. 92	0. 52	3. 70	3. 94
15º		0. 15	1. 21	1. 30	0. 46	3. 30	3. 52	0. 78	4. 55	4. 84
20º		0. 20	1. 41	1. 50	0. 62	3. 86	4. 11	1. 03	5. 39	5. 72
25º		0. 26	1. 60	1. 71	0. 77	4. 41	4. 70	1. 29	6. 22	6. 60
30º		0. 31	1. 79	1. 91	0. 92	4. 95	5. 27	1. 54	7. 04	7. 47
35º		0. 36	1. 98	2. 11	1. 07	5. 48	5. 84	1. 79	7. 84	8. 32
40º		0. 40	2. 16	2. 31	1. 21	6. 00	6. 39	2. 03	8. 64	9. 15
45º		0. 45	2. 34	2. 50	1. 36	6. 52	6. 94	2. 27	9. 41	9. 97
50º		0. 50	2. 52	2. 69	1. 50	7. 02	7. 47	2. 51	10. 17	10. 77
55º		0. 55	2. 68	2. 86	1. 64	7. 50	7. 98	2. 74	10. 90	11. 55
60º		0. 59	2. 85	3. 04	1. 78	7. 97	8. 48	2. 97	11. 62	12. 31
65º		0. 63	3. 01	3. 21	1. 91	8. 43	8. 97	3. 19	12. 32	13. 04
70º		0. 68	3. 16	3. 37	2. 04	8. 87	9. 44	3. 41	12. 99	13. 75
75º		0. 72	3. 31	3. 53	2. 16	9. 29	9. 89	3. 62	13. 64	14. 43
80º		0. 76	3. 45	3. 68	2. 28	9. 70	10. 31	3. 82	14. 26	15. 09
85º		0. 80	3. 59	3. 83	2. 40	10. 09	10. 73	4. 01	14. 85	15. 71
90º		0. 84	3. 71	3. 96	2. 51	10. 46	11. 12	4. 20	15. 42	16. 31
Termination		0. 59	2. 33	2. 48	1. 77	6. 63	7. 04	2. 96	9. 94	10. 50

Notes:

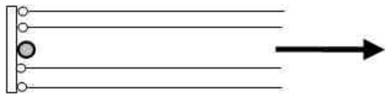
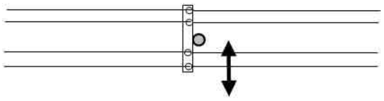
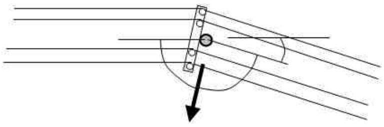
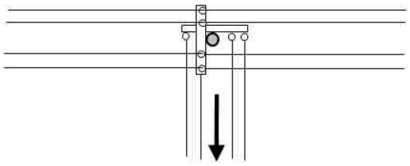
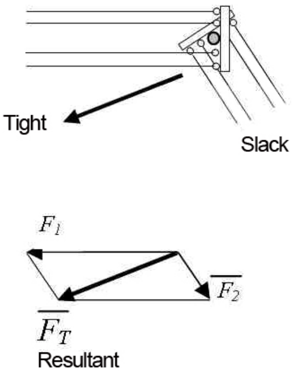
1. Loads are in kilonewtons (kN), are per Conductor, and in the horizontal plane (essentially).
2. Stringing tensions in %UTS are at standard temperature of 5ºC.
3. Loads include load factors of 1. 1 for the everyday limit state (sustained or no wind condition) and 1. 25 for the ultimate strength limit state (maximum wind condition).
4. Loads have been calculated with TL-Pro, which does not check for worst case wind direction. Some discrepancies may be evident with hand calculations or other software at large deviation angles. Rural wind pressure incorporates nominal SRF as per Clause 5. 2.
5. The values tabulated will cover the majority of situations. However, if span length is significantly larger than assumed span length shown or if the area is prone to microbursts, a full calculation should be carried out or design software used.

12.1.9 CCT 180mm^2

Deviation Angle 	Stringing Tension	SLACK 2% UTS			URBAN 6% UTS			SEMI-URBAN 10% UTS		
	Assumed Span Length (see Note 5)	30m			80m			100m		
	Load Condition	Sustained 5ºC	Max. Wind 15ºC		Sustained 5ºC	Max. Wind 15ºC		Sustained 5ºC	Max. Wind 15ºC	
			Urban 900Pa	Rural 966Pa		Urban 900Pa	Rural 966Pa		Urban 900Pa	Rural 966Pa
0º		0. 00	0. 70	0. 75	0. 00	1. 83	1. 96	0. 00	2. 27	2. 44
5º		0. 08	0. 96	1. 03	0. 24	2. 57	2. 75	0. 40	3. 39	3. 62
10º		0. 14	1. 22	1. 31	0. 48	3. 32	3. 54	0. 80	4. 51	4. 80
15º		0. 24	1. 49	1. 59	0. 71	4. 06	4. 32	1. 19	5. 62	5. 96
20º		0. 32	1. 74	1. 86	0. 95	4. 79	5. 10	1. 59	6. 71	7. 12
25º		0. 39	2. 00	2. 13	1. 18	5. 51	5. 86	1. 98	7. 80	8. 26
30º		0. 47	2. 25	2. 40	1. 42	6. 22	6. 61	2. 37	8. 87	9. 39
35º		0. 55	2. 49	2. 65	1. 65	6. 92	7. 35	2. 75	9. 92	10. 50
40º		0. 62	2. 73	2. 91	1. 87	7. 61	8. 08	3. 13	10. 95	11. 59
45º		0. 70	2. 97	3. 16	2. 10	8. 28	8. 79	3. 50	11. 96	12. 65
50º		0. 77	3. 20	3. 41	2. 31	8. 93	9. 49	3. 87	12. 96	13. 70
55º		0. 84	3. 42	3. 64	2. 53	9. 57	10. 16	4. 22	13. 92	14. 71
60º		0. 91	3. 64	3. 88	2. 74	10. 19	10. 82	4. 58	14. 86	15. 70
65º		0. 98	3. 85	4. 10	2. 94	10. 79	11. 46	4. 91	15. 77	16. 66
70º		1. 04	4. 05	4. 32	3. 14	11. 38	12. 08	5. 25	16. 65	17. 59
75º		1. 11	4. 25	4. 53	3. 33	11. 94	12. 67	5. 57	17. 50	18. 48
80º		1. 17	4. 44	4. 73	3. 52	12. 47	13. 24	5. 88	18. 32	19. 34
85º		1. 23	4. 62	4. 92	3. 70	12. 99	13. 78	6. 18	19. 10	20. 16
90º		1. 29	4. 79	5. 10	3. 87	13. 47	14. 30	6. 47	19. 85	20. 95
Termination 		0. 82	3. 04	3. 24	2. 73	8. 64	9. 16	4. 56	12. 92	13. 62

Notes:
1. Loads are in kilonewtons (kN), are per Conductor, and in the horizontal plane (essentially).
2. Stringing tensions in %UTS are at standard temperature of 5ºC.
3. Loads include load factors of 1. 1 for the everyday limit state (sustained or no wind condition) and 1. 25 for the ultimate strength limit state (maximum wind condition).
4. Loads have been calculated with TL-Pro, which does not check for worst case wind direction. Some discrepancies may be evident with hand calculations or other software at large deviation angles. Rural wind pressure incorporates nominal SRF as per Clause 5. 2.
5. The values tabulated will cover the majority of situations. However, if span length is significantly larger than assumed span length shown or if the area is prone to microbursts, a full calculation should be carried out or design software used.

12.2 Resultant forces for various circuit configurations

Circuit configuration	Plan view and resultant force direction	Analysis
Termination		Resultant force is in direction of the circuit. Read values from bottom row of Table 12. 1. x.
Straight Line Intermediate		Longitudinal forces on either side will cancel each other out. Sustained load will be nil. Resultant force is due to transverse wind loading and comparatively small. Resultant may be in either direction normal to the line. Read Max. Wind. load values from 0º deviation row of Table 12. 1. x.
Deviation Angle Intermediate		Resultant force direction will generally bisect the angle between the two circuits. Read values from relevant deviation angle row of Table 12. 1. x.
Tee-Off		The through circuit forces can generally be ignored—only need to consider the tee-off circuit. Resultant force will be in direction of the tee-off. (See Note 4) Read values from bottom row of Table 12. 1. x.
Complex		Treat each circuit as a termination, reading values from the bottom row of Table 9. 1. x. The force vectors corresponding to each circuit need to be summed; do not simply add them arithmetically. Note that resultant force directions for Sustained and Max. Wind conditions may differ slightly.

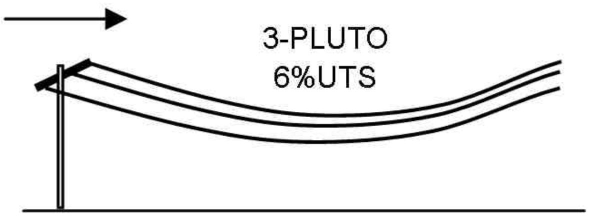
Notes:

1. For the Max. Wind condition, add pole windage (refer Clause 9.2) and windage of any large plant items (refer Clause 11.6).
2. Values in tables in Clause 12.1 are per conductor—multiply by number of conductors.
3. Scale down forces for circuits attached a significant distance below the tip.
4. For a tee-off, the worst case wind direction is usually normal to the tee-off circuit, i. e. in line with and having no effect on the through circuit.

12.3 Worked examples

EXAMPLE 1 – Pole with single 11kV bare conductor termination

Determine the tip load applied to a pole by a 60m span of PLUTO (19/3. 75 AAC) 11kV mains strung at URBAN 6%UTS. The pole is a normal line situated in an urban area. If the pole is 12.5m long and has 8kN working strength (32kN ultimate strength), will it need to be stayed?



Let us turn to Clause 12.1.2, the mechanical load tables for PLUTO. We find the column headed URBAN 6% UTS. (Notice that the assumed span length for this column is 80m, which exceeds the span length above, so the results obtained will be on the conservative side.) The bottom row of the table gives loads for terminations.

Deviation Angle	Stringing Tension	SLACK 2% UTS			URBAN 6% UTS		
	Assumed Span Length (see Note 5)	30m			80m		
			Max. Wind 15°C			Max. Wind 15°C	
	Load Condition	Sustained 5°C	Urban 900Pa	Rural 966Pa	Sustained 5°C	Urban 900Pa	Rural 966Pa
0°		0.00	0.54	0.58	0.00	1.39	1.49
5°		0.06	0.75	0.80	0.18	1.98	2.11
10°		0.12	0.95	1.01	0.37	2.56	2.74
15°		0.18	1.15	1.23	0.55	3.14	3.35
20°		0.24	1.35	1.44	0.73	3.72	3.96
25°		0.30	1.55	1.65	0.91	4.28	4.56
30°		0.36	1.74	1.86	1.08	4.84	5.16
35°		0.42	1.93	2.06	1.26	5.39	5.74
40°		0.48	2.12	2.26	1.43	5.93	6.31
45°		0.53	2.30	2.45	1.60	6.46	6.87
50°		0.59	2.48	2.65	1.77	6.98	7.42
55°		0.64	2.65	2.83	1.93	7.48	7.95
60°		0.70	2.82	3.01	2.09	7.97	8.47
65°		0.75	2.90	3.19	2.25	8.44	8.98
70°		0.80	3.15	3.35	2.40	8.90	9.46
75°		0.85	3.30	3.52	2.55	9.34	9.93
80°		0.90	3.45	3.67	2.69	9.77	10.38
85°		0.94	3.59	3.82	2.83	10.17	10.81
90°		0.99	3.72	3.96	2.96	10.56	11.21
Termination		0.69	2.36	2.52	2.09	6.79	7.21

We obtain the following values:

Sustained Load: 2. 09kN per conductor x 3 = 6. 27kN
Max. Wind Load (Urban 900Pa): 6. 79kN per conductor x 3 = 20. 37kN

Note that there will also be wind load upon the structure itself, which can be obtained from the Wood Pole Data table in Clause 9. 2.1 ie 2.03kN. This value is then added to the Max. Wind Load above to obtain a total of 22. 40kN.

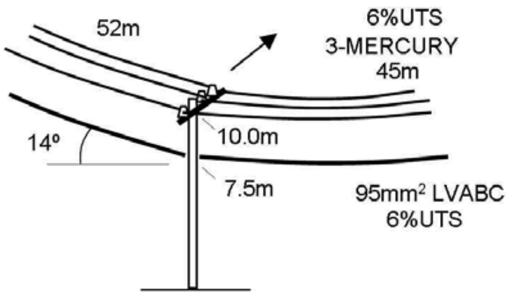
Comparing loads and strength (from Clause 9.2.1):

Load Case	Load	Strength	Remarks
Sustained	6. 27kN	11. 20kN	OK
Maximum Wind	22. 40kN	19. 20kN	Load exceeds strength. Need a stay or replace pole with 12kN/48kN.

EXAMPLE 2 – HV/LV pole with deviation angle

Determine the tip load applied to an urban 12.5m 8kN working strength (32kN ultimate strength) pole by both 11kV mains MERCURY (7/4. 50 AAC) and 4C 95mm^2 LVABC attached 2.5m below. The stringing tension for both HV and LV is URBAN 6%UTS, and the deviation angle is 14°.

Let us turn to Clause 12.1.1, the mechanical load tables for MERCURY.



Deviation Angle	Stringing Tension	SLACK 2% UTS			URBAN 6% UTS		
	Assumed Span Length (see Note 5)	30m			80m		
	Load Condition	Sustained 5ºC	Max. Wind 15ºC Urban 900Pa	Max. Wind 15ºC Rural 966Pa	Sustained 5ºC	Max. Wind 15ºC Urban 900Pa	Max. Wind 15ºC Rural 966Pa
0º		0.00	0.31	0.33	0.00	0.92	0.99
5º		0.03	0.55	0.59	0.10	1.42	1.52
10º		0.06	0.69	0.74	0.19	1.83	1.95
15º		0.10	0.83	0.89	0.29	2.23	2.38
20º		0.13	0.97	1.04	0.39	2.63	2.80

We find the column headed URBAN 6% UTS. We now look at the row for a 15º deviation angle. In this instance, we have rounded 14º up to 15º, but if we wished to be more precise, we could interpolate between 10º and 15º. We obtain the following values:

Sustained Load: 0. 29kN per conductor x 3 = 0. 87kN
Max. Wind Load (urban 900Pa): 2. 23kN per conductor x 3 = 6. 69kN

Let us now turn to Clause 12.1.5, the mechanical load tables for LVABC 95mm^2. Here we obtain the values for a 15º deviation.

Deviation Angle	Stringing Tension	SLACK 2% UTS			URBAN 6% UTS		
	Assumed Span Length (see Note 5)	30m			80m		
	Load Condition	Sustained 5ºC	Max. Wind 15ºC Urban 900Pa	Max. Wind 15ºC Rural 966Pa	Sustained 5ºC	Max. Wind 15ºC Urban 900Pa	Max. Wind 15ºC Rural 966Pa
0º		0.00	0.99	1.07	0.00	2.62	2.82
5º		0.10	1.30	1.39	0.30	3.52	3.77
10º		0.20	1.60	1.71	0.61	4.42	4.72
15º		0.30	1.91	2.04	0.91	5.30	5.66
20º		0.40	2.20	2.35	1.21	6.18	6.59

Note that there is a single cable and there is no need to multiply by the number of cores. However, because this force is applied below the tip, we de-rate the loads, multiplying by the attachment height (7.5m) divided by the tip height (10.0m).

Sustained Load: 0. 91kN x 7. 5 / 10. 0 = 0.68kN
Max. Wind Load (urban 900Pa): 5. 30kN x 7. 5 / 10. 0 = 3.98kN

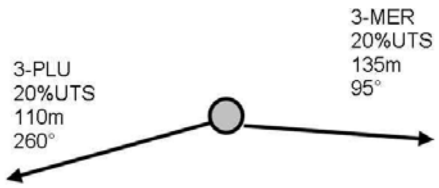
We can now sum the loads applied by the two circuits. This is a simple arithmetic sum, as the loads are in the same direction, viz. bisecting the deviation angle. Note that there will also be wind load upon the structure itself (2. 03kN), which can be obtained from the Clause 6. 2. 1. Thus we have total loads of:

Sustained Load: 0. 87kN (HV) + 0.68kN (LV) = **1.55kN**
Max. Wind Load (urban 900Pa): 6. 69kN (HV) + 3.98kN (LV) + 2.03kN (pole) = **12.70kN**

EXAMPLE 3 – Two terminations

Determine the tip load applied to a 12.5m 12kN working strength (48kN ultimate strength) pole in open rural country. Two 11kV circuits terminate on the pole - a circuit of MERCURY from the east and a circuit of PLUTO from the west, with approx. 15° deviation.

Let us turn to Clause 12.1.1, the mechanical load tables for MERCURY AAC. We find the column for 20% UTS, Rural Wind pressures, and the bottom row for a termination.



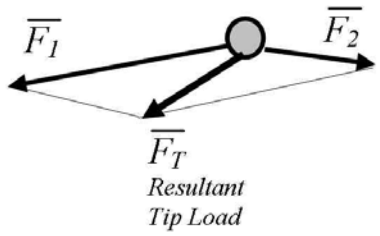
Deviation Angle	Stringing Tension	SLACK 2% UTS			URBAN 6% UTS			SEMI-URBAN 12% UTS			RURAL 20% UTS		
	Assumed Span Length (see Note 5)	30m			80m			130m			180m		
	Load Condition	Sustained 5°C	Max. Wind 15°C Urban 900Pa	Max. Wind 15°C Rural 966Pa	Sustained 5°C	Max. Wind 15°C Urban 900Pa	Max. Wind 15°C Rural 966Pa	Sustained 5°C	Max. Wind 15°C Urban 900Pa	Max. Wind 15°C Rural 966Pa	Sustained 5°C	Max. Wind 15°C Urban 900Pa	Max. Wind 15°C Rural 966Pa
0°		0.00	0.31	0.33	0.00	0.92	0.99	0.00	1.62	1.74	0.00	2.18	2.34
5°		0.03	0.55	0.59	0.10	1.42	1.52	0.19	2.24	2.40	0.32	3.20	3.44
10°		0.06	0.69	0.74	0.19	1.83	1.95	0.40	3.05	3.25	0.63	4.26	4.53
85°		0.50	2.53	2.71	1.50	7.09	7.55	2.87	11.48	12.15	4.90	17.81	18.78
90°		0.52	2.63	2.80	1.57	7.36	7.83	3.00	11.83	12.53	5.13	18.50	19.50
Termination		0.33	1.34	1.43	1.11	4.72	5.02	2.22	8.45	8.93	3.62	12.02	12.65

We obtain the following values:

Sustained Load: 3. 62kN per conductor x 3 = 10. 86kN
Max. Wind Load (Rural 966Pa): 12. 02kN per conductor x 3 = 36. 06kN

Now let us turn to Clause 12.1.2, the mechanical load tables for PLUTO AAC. Similarly, we find the column for 20% UTS, Rural Wind pressures, and the bottom row for a termination. We obtain the following values:

Sustained Load: 6. 83kN per conductor x 3 = 20. 49kN
Max. Wind Load (Rural 966Pa): 18. 15kN per conductor x 3 = 54. 45kN



We now need to perform a vector summation of the loads. We can do this graphically or on a scientific calculator. For the sustained load case, the resultant load is:

F_{Tsus} = 10. 86 < 95° + 20. 49 < 260° = 10. 39kN @ 244°

For the maximum wind load case:

$F_{Twind\ cond}$ = 36. 06 < 95° + 54. 45 < 260° = 21. 73kN @ 235°

We also have to allow 2. 38kN for structure self-windage (from Clause 6. 2. 1), so then

F_{Twind} = 24. 11kN @ 235°

Comparing this with the pole tip load capacity given in Clause 9.2.1, we find that it is not necessary to stay the pole.

Load Case	Load	Strength
Sustained	10. 39kN	16. 52kN
Maximum Wind	24. 11kN	28. 98kN

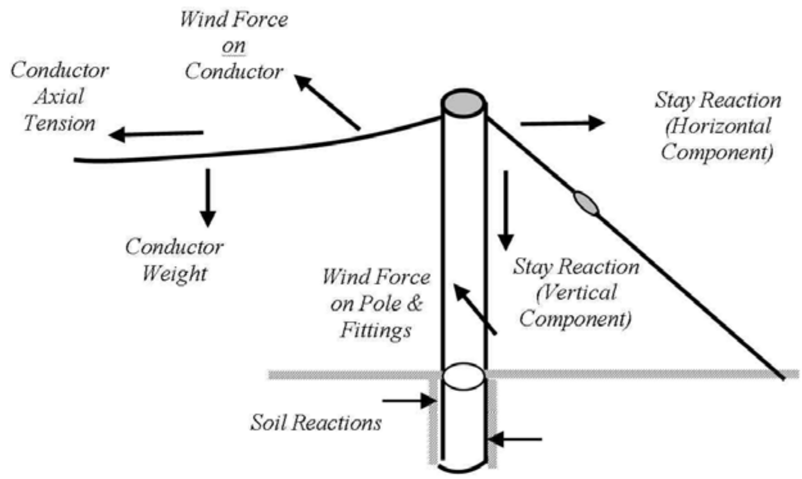
[The slight difference between the resultant tip load directions for sustained and maximum wind conditions (235° vs. 244°) is of no great concern. When positioning stays, designers may need to find a compromise between these two directions.]

12.4 Engineering notes

Overview of forces

Numerous forces act upon a pole. These include:

- horizontal forces applied to the top of the pole by attached conductors - some in line with the conductors, others in the transverse direction
- downward forces due to the weight of crossarms, insulators, plant and conductors
- horizontal force distributed over the pole, crossarms and insulators due to the action of wind
- the passive reaction of the foundation
- the passive reaction of the stay, with horizontal and downward compressive components.

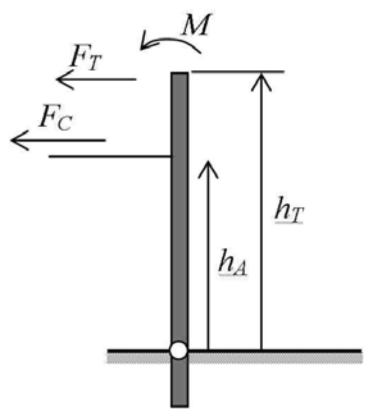


For calculation purposes, poles are assumed to be rigid, although in reality there is some deflection of the pole which usually has the effect of reducing conductor tension.

Conductor height attachment and overturning moment

The overturning moment, *M*, applied to the pole by the conductors depends upon:

- conductor tension, F_C
- number of conductors, *n*
- conductor height of attachment, h_A



Thus:

$$M = n\, F_C\, h_A$$

(This assumes ground level to be the pivot point for convenience. In reality, the pivot point may be lower, typically two thirds of the embedment depth below ground in homogenous soil.)

Rather than work with overturning moments, distribution designers generally work with an equivalent tip load, F_T:

$F_T = n\ F_C\ h_A / h_T$

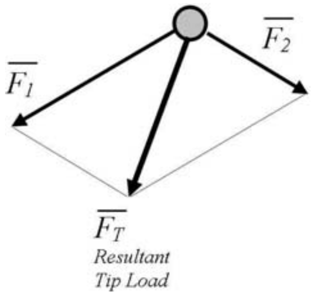
where h_T is the tip height.

Thus, where conductors are attached at the pole tip, the tip load is equal to the full conductor force, but where attached below the tip, the tip load is de-rated in proportion to the attachment height relative to the tip height.

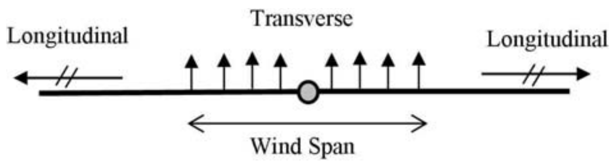
Vector Addition of Conductor Loads

As vector quantities, each conductor force has both magnitude and direction. The forces cannot simply be added together arithmetically unless they are in the same direction.

$\overline{F}_T = \overline{F}_1 + \overline{F}_2$ (note: vector addition)



Wind force on conductor



Conductor forces have two horizontal components:

- transverse force, essentially the product of wind pressure and the projected area of the conductor over the wind span, and
- axial or longitudinal conductor tension.

The transverse wind force on the conductor may be calculated as follows:

$W_T = \quad 0.5\ L\ d\ P\ C\ F_{SR} \cos^2 \alpha$

where:

W_T	= transverse force applied to pole due to conductor windage (kN)
L	= span length (m)
d	= projected diameter of conductor (m)
P	= design wind pressure on conductor (kPa)
C	= drag coefficient of conductor (default value of 1. 0)
F_{SR}	= Span Reduction Factor (defaults to 1. 0, reducing on long spans)
α	= angle between wind direction and normal to the conductor

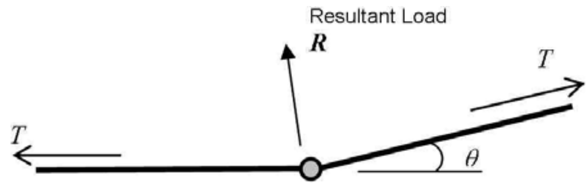
The wind span is taken to be half of the span length, i. e. only one half of each attached span is deemed to load the pole in question, the other half affecting the adjacent pole/s, and thus the factor of 0. 5. Note that where the wind is normal to the conductor, transverse force is at a maximum.

Generally, transverse wind force is minor compared with longitudinal forces, and is often ignored except for straight line intermediate poles or poles with small deviation angles.

For long spans, a span reduction factor (SRF) may be applied, particularly in non-urban areas (refer Clause 5. 5).

The axial or longitudinal conductor force, under no wind conditions, depends upon the stringing tension used and the temperature. Under wind conditions, though, the uniformly distributed load on the conductor — the vector sum of weight in the downward direction and wind action in the horizontal direction — increases substantially and conductor tension increases accordingly.

Conductor forces on a deviation angle pole



For a deviation angle θ on a line, with equal conductor tensions either side, the resultant force direction bisects the angle between the conductors. The *R* resultant force is:

$$R = 2\,T\,n\,\sin(\theta/2)$$

where:

T	is the tension in each conductor
n	is the number of conductors.

For the Everyday (No Wind) load condition, the resultant is readily calculated using the above equation. However, for the Maximum Wind load condition, the question of wind direction arises. Obviously, the wind cannot be normal to both conductors at the same time. For smaller angles, the worst case loading of the pole occurs when the wind direction bisects the angle between the conductors.

Effect of minor cables

All Loads on poles due to services or telephony cables need to be considered in design calculations.

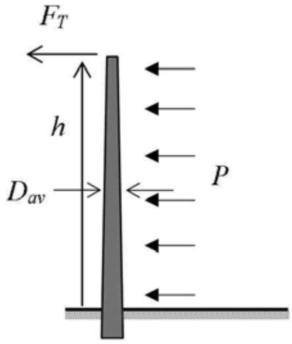
Wind load of pole, crossarms and fittings

The wind load on a round pole, resolved to its tip, is as follows:

$$F_T = 0.5\,h\,D_{av}\,P$$

where:

F_T	tip load due to wind on pole (kN)
h	pole height above ground (m)
P	design wind pressure on pole (kPa)
D_{av}	average diameter of pole (m)



The 0.5 accounts for the centre of pressure being midway up the pole. (On taller structures, higher values may be used since wind strengths generally increase with height.)

Note that pole design wind pressures are generally higher than those applied to conductors because of the larger face and different drag coefficient. The design wind pressure will depend upon whether the pole structure is round or rectangular in section, smooth or rough. For round wood poles, a design wind pressure of 1. 3kPa is used in Ausgrid.

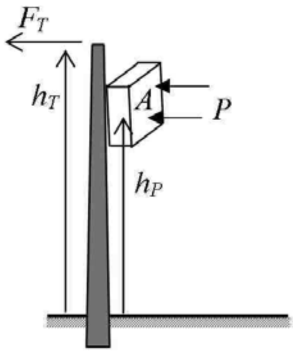
For distribution applications, windage on crossarms, insulators and other fittings is often allowed for by applying a multiplier of, say 1.1, rather than by detailed calculation.

Plant loads

Loading due to small items(less than 0. 1m^2 surface area) of plant can generally be ignored.

For larger plant items, tip load may be calculated as follows:

$F_T = P\ A\ h_P / h_T$



where:

F_T	tip load due to wind on pole (kN)
P	design wind pressure on plant (kPa) – 2. 3kPa
A	area of face of plant (m^2)
h_T	pole tip height (m)
h_P	height of centre of plant item(m)

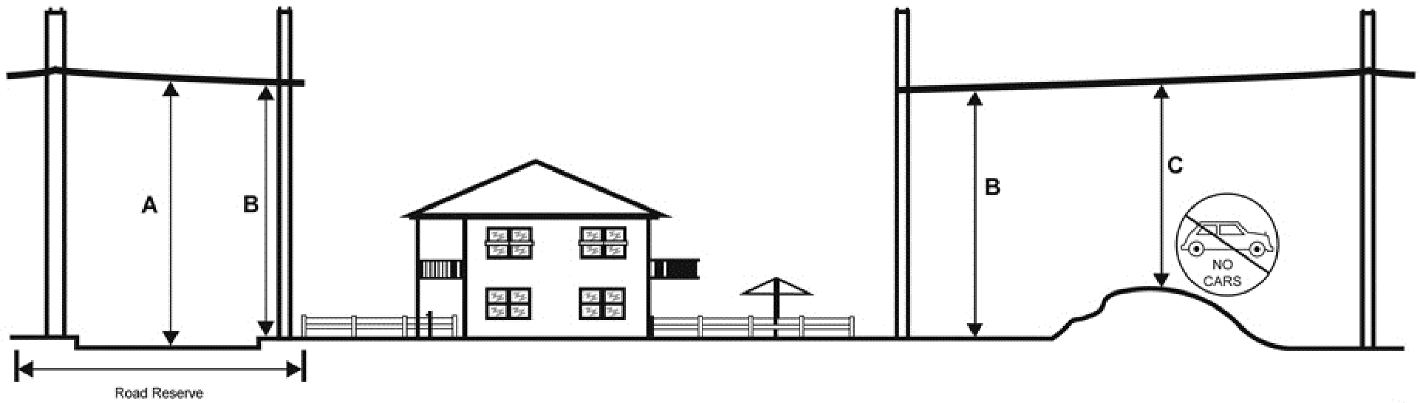
Designers should consider column buckling effects where heavy plant items are supported by relatively slender columns or thin-walled steel poles. (See Reference 23 Annexure F)

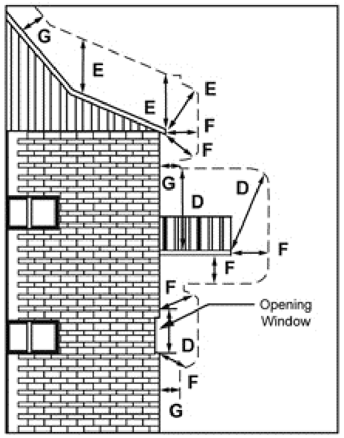
13.0 CLEARANCES

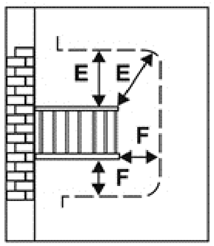
13.1 Ground and structure clearances

13.1.1 Distribution lines (mains)

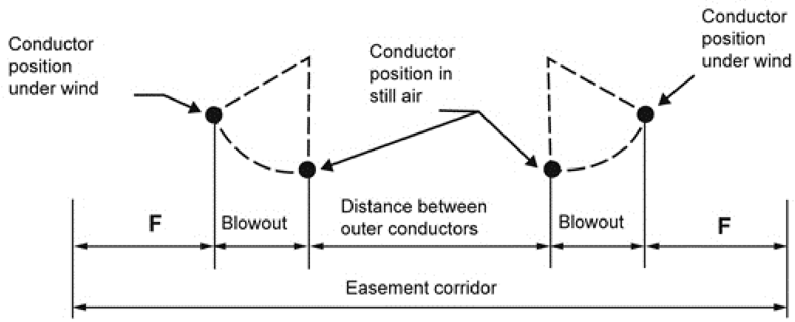
MAINS (for dimensions see Tables 13.1.2a and b)







These dimensions apply if the height of the railing (or similar) plus distance E is greater than distance D



HORIZONTAL CLEARANCE BETWEEN CONDUCTORS AND EASEMENT BOUNDARIES

13.1.2 Distribution lines (mains)

Table 13.1.2a: Minimum Clearance from Roads, Ground or Boundaries

DIMENSION	LOCATION	Minimum Clearances in any direction between Conductors					
		Nominal System Voltage					
		LV insulated or bare	11kV, 22kV, and 12. 7kV SWER bare	11kV, 22kV, and 12. 7kV SWER covered	33kV	66kV	132kV
		m	m	m	m	m	m
A	Over the carriageway of roads1	6. 0 (5. 5)	7. 5 (6. 7)	6. 0	7. 5 (6. 7)	7. 5 (6. 7)	7. 5 (6. 7)
B	Over land other than the carriageway of roads	6. 0 (5. 5)	6. 0 (5. 5)	6. 0	6. 0 (5. 5)	7. 0 (6. 7)	7. 5 (6. 7)
C	Over land which, due to its steepness or swampiness, is not traversable by vehicles	5. 0 (4. 5)	5. 0 (4. 5)	5. 0	5. 0 (4. 5)	6. 0 (5. 5)	6. 0 (5. 5)

Table 13.1.2b: Minimum Clearance from Structures and Buildings

DIMENSION	LOCATION	LOW VOLTAGE			11kV – 33kV			66kV to 132kV
		Insulated	Bare neutral	Bare active	Insulated with earthed screen	Insulated without earthed screen	Bare or covered	Bare
		m	m	m	m	m	m	m
D	Vertically above those parts of any structure normally accessible to persons	2. 7	2. 7	3. 7	2. 7	3. 7	4. 5	5. 0
E	Vertically above those parts of any structure not normally accessible to persons but on which a person can stand	0. 1	2. 7	2. 7	2. 7	2. 7	3. 7	4. 5
F	In any direction (other than vertically above) from those parts of any structure normally accessible to persons, or from any part not normally accessible to persons but on which a person can stand	0. 1	0. 9	1. 5	1. 5	1. 5	2. 1	3. 0
G	In any direction from those parts of any structure not normally accessible to persons	0. 1	0. 3	0. 6	0. 1	0. 6	1. 5	2. 5

Notes for Tables 13.1.2a and b:

1. The design clearance requirements shown exceed those provided for in Regulations, Codes or Agreements (shown in brackets in the table). They include a margin to allow for minor inaccuracy in surveying and construction, as well as some small movement over time.
2. These tables indicate the minimum clearances required in the design of overhead lines under the ordinarily expected worst combination of weather conditions and current loadings. These clearances shall be achieved in all new designs and major reconstructions, subject to approval by Ausgrid. In special circumstances, a lesser figure may be acceptable. Under no circumstances will clearances be reduced below the statutory requirements listed.
3. Minimum clearances shown must be met when the upper circuit conductors are at their maximum design operating temperature.
4. Additional clearance should be allowed if there is likely to be a future lower circuit constructed along the road or in special circumstances such as private roads and adjacent parts of public roads especially in mining and heavy industrial sites
5. Greater clearances over roads may be required where regular high loads are likely eg New England Highway, Golden Highway.
6. Dimensions D and E should not be taken as meaning only the literal vertical. The actual clearance may also extend outwards in an arc until it intersects with the relevant F dimension clearance.
7. “Covered “conductor is not metallically screened and so is not touch safe.

13.1.3 Ground and structure clearances – service cables

SERVICES (for dimensions see Table 13.1.4)

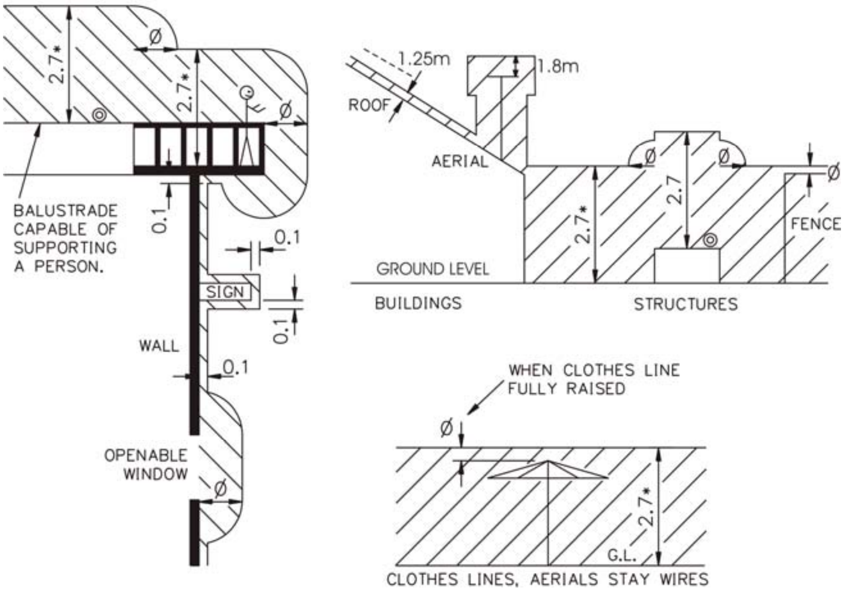


Figure 13.1.3a: Typical Clearance Situations – Elevation

Note: ∅ 'Out of normal reach' = 1. 25m
* Not used by vehicles
◎ Surface

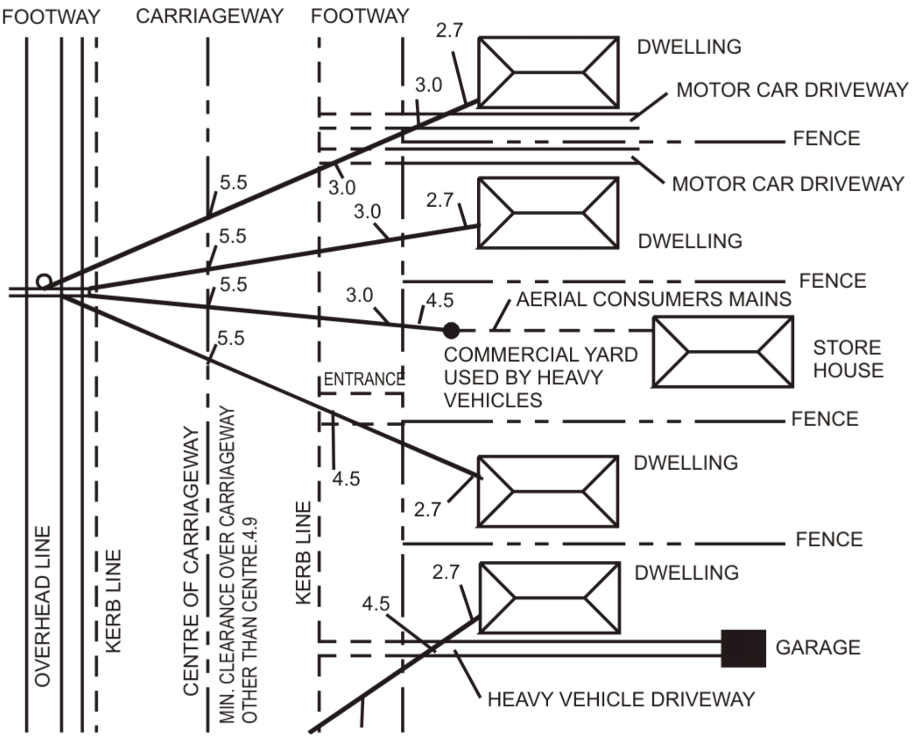


Figure 13.1.3b: Typical Clearance Situations – Plan

Note: These clearances must be achieved under all conditions (refer to Note 3 of Table 13.1.4)

13.1.3.1 Service clearances from structures, vegetation and ground

Maintain minimum clearances above ground, and from trees, shrubs and structures, when calculating the height of the supports required for the service. Minimum clearances depend on:

(a) Whether the ground under the service is likely to be used by vehicular traffic.

(b) The nature of any nearby structure.

(c) Trees and shrubs. Make adequate allowance for growth and the effect of wind. A minimum clearance of 1.5m is required from bare conductors and 0.5m from insulated conductors.

(d) The required clearances are set out in Table 13.1.4 and illustrated in Figures 13.1.3a, 13.1.3b and 13.1. 5.

(e) Allow for any proposal to change the ground level or build a structure along the route of the overhead service. Overhead services must not be installed where the required clearances are not obtainable at the time of installation.

(f) The take-off from the electricity distributor’s pole for the overhead service will be in the vicinity of the low voltage crossarm. The height of the crossarm typically varies between 6.7 and 8 metres.

(g) When selecting the point of attachment and route of the overhead service, allow for:

   (i) The maximum sag when determining the final ground clearance, and

   (ii) The swing of conductors for clearance to structures.

Table 13.1.4: Minimum Clearances to Insulated Overhead Service

	From the insulated service conductors to the surface of:	Minimum clearances (metres)
1	Any part of a freeway or arterial road	5. 5 vertically
2	The centre of a carriageway of a public road	5. 5 vertically
3	Any part of a carriageway of a public road (other than the centre)	4. 9 vertically
4	Vehicular crossing of a footway in a public road (other than a residential driveway)	4. 5 vertically
5	Vehicular crossing of a footway in a public road for a residential driveway and any other part of a footway	3. 0 vertically
6	Land which is not associated with a dwelling and which is likely to be used by vehicles, including non urban small acreages and hobby farms	4. 5 vertically
7	Land which is, or is likely to be used by vehicles and is associated with a dwelling	3. 0 vertically
8	Land not likely to be used by vehicles	2. 7 vertically
9	Those parts of any structure normally accessible to persons. (See Note 1)	2. 7 vertically
10	Any area above a roof	1. 25 metres
11	Any area around a radio or TV aerial	1. 8
12	Those parts of any structure not normally accessible to persons. (See Note 2) (including below a projecting slab, balcony or sign)	0. 1 in any direction
13	The edge of any opening window, balcony, verandah, clothes line or fence etc	Out of normal reach (see Note 4)
14	Point of attachment	3m vertically not normally accessible without a ladder or other device (see Notes 1-4)
15	Farmland where mechanical equipment is used	5. 5 vertically
16	Trees and shrubs	0. 5 in any direction
17	Vicinity of boat ramps, launching areas (avoid if possible)	10. 0 vertically
18	Communications conductors	0. 6 in any direction

Notes:

Interpret the requirements set out in Table 13.1.4 as follows:

1. Structure Normally Accessible to Persons includes:
   (a) The whole area of any flat roof accessible without the use of a ladder.
   (b) Any part of a hip or gable roof accessible without a ladder up to the nearest hip or gable.
   (c) Any portion of a balustrade or other structure which will support a person and is accessible without a ladder.
2. Not Normally Accessible to Persons excludes roofs and includes any portion of a fence, balustrade, advertising sign or other structure which will not support a person or is not accessible without a ladder.
3. The minimum clearances in Table 13.1.4 must be achieved under all conditions regardless of:
   (a) Conductor swing due to the influence of wind.
   (b) Conductor sag due to the influence of load current and ambient temperature.

   The requirements of Table 13.1.4 may be achieved if the maximum allowable service line sag for a particular conductor size and span is added to the minimum clearance. Refer to Table 3.8 of Reference 57.
4. Out of Normal Reach means 1.25m from any normally accessible position. The requirement that an overhead service must be out of normal reach of persons may be achieved in some cases by the provision of a permanent insulated barrier (consult with the electricity distributor).

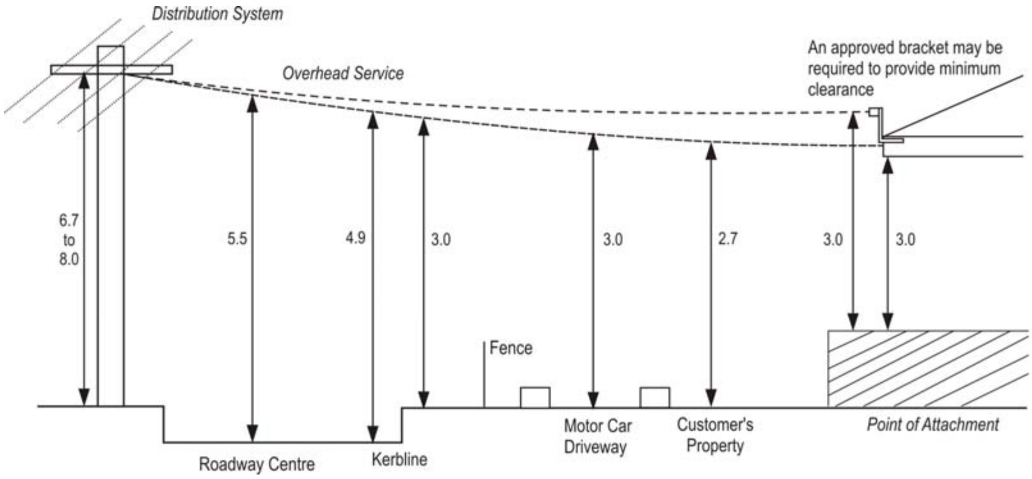


Figure 13.1.5: Clearances to Overhead Service - Elevation

Note:

1. These clearances must be achieved under all conditions (refer to Note 3 of Table 13.1.4)
2. The point of attachment is to be 3m minimum above the ground, floor or platform level.

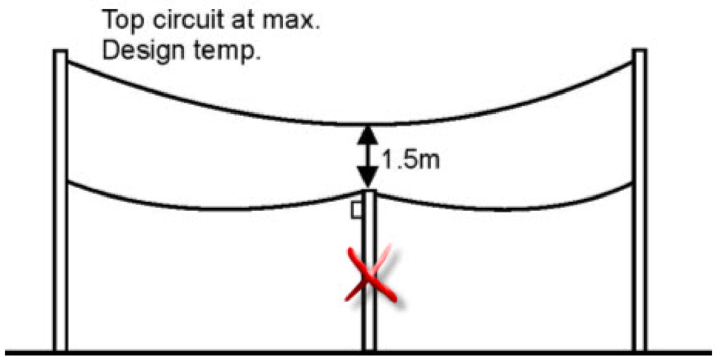
13.1.4 Clearances to other utility services

The accredited service provider is responsible for obtaining the required minimum clearance of 600mm between the proposed overhead service and aerial communications conductors.

13.2 Intercircuit spacing

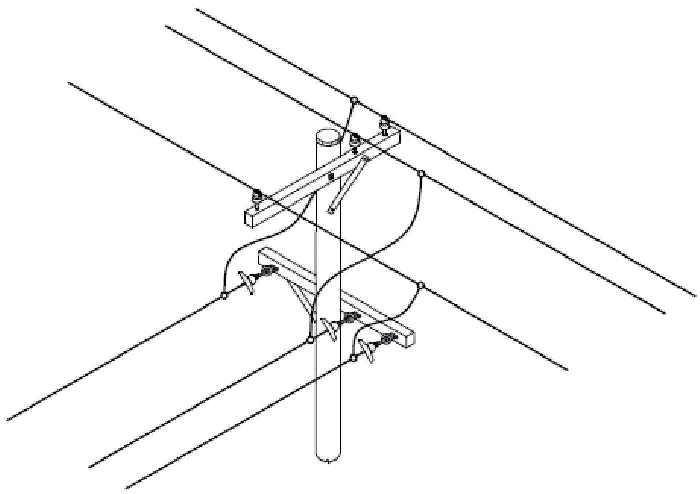
13.2.1 Clearance to interspan pole

Clearance issues to an existing Interspan pole is solved by replacing the Interspan pole with a full height pole and attaching top and bottom circuits.



Note: Unattached short height intermediate poles should not be used in new designs.

13.2.2 Same support structure, same electrical circuit



Lower Circuit \ Upper Circuit	LV Open wire	LV ABC	11kV, 22kV, 12. 7kV SWER Bare or CCT
	m	m	m
LV open wire	0. 61		-
LV ABC	0. 31	0. 61	-
11kV, 22kV, 12. 7kV SWER Bare or CCT			0. 752

Notes:

1. This separation represents a circuit conductor spacing.
2. The 0. 75m separation represents the king bolt spacing between the upper and lower circuits

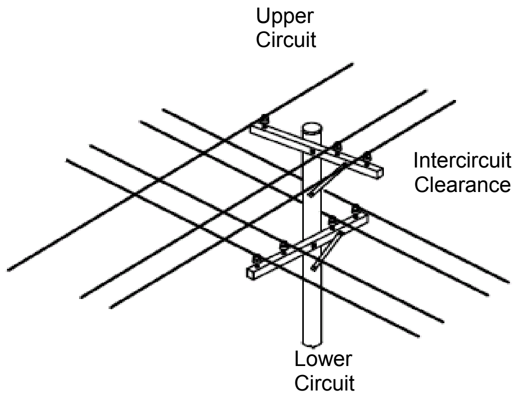
13.2.3 Same support structure, separate electrical circuits

Lower Circuit	Upper Circuit										
	132kV bare		66kV bare		11kV, 33kV, 12. 7kV SWER bare, covered or insulated		22kV	LV bare and covered	LV insulated	Other cables – conductive	Other cables – non-conductive
	LL	Non LL	LL	Non LL	LL	Non LL	m	m	m	m	m
	m	m	m	m	m	m					
11kV, 22kV, 33kV, 12. 7kV SWER bare, covered or insulated	2. 5	2. 4	2. 5	1. 5	2. 5	1. 2	2. 5				
LV bare, covered	2. 5	2. 4	2. 5	1. 8	2. 5	1. 2	2. 5	1. 2	1. 2		
LV insulated	2. 5	2. 4	2. 5	1. 8	2. 5	1. 2	2. 5	1. 2	1. 2	0. 3	
Other cables – conductive	2. 5	2. 4	2. 5	1. 8	2. 5	1. 2	2. 5	0. 3	0. 3	0. 2	0. 2
Other cables – non-conductive	2. 5	1. 2	2. 5	1. 8	2. 5	1. 2	2. 5	0. 3	0. 2	0. 2	0. 2

LL – Live line area including all new lines
Non LL – Non live line area or existing line built to older spacings

Notes:

1. New Insulated 11kV circuits including HVABC are not allowed on Ausgrid network.
2. The separation represents the conductor spacing. In areas where the 11kV network cannot be worked on using live line techniques, lower circuits shall be installed with a minimum clearance of 1. 2m. In areas where the 11kV network can be worked on using live line techniques, lower circuits shall be installed with a minimum clearance of 2. 5m.
3. Refer to NS214 - Guide to Live Line Design Principles

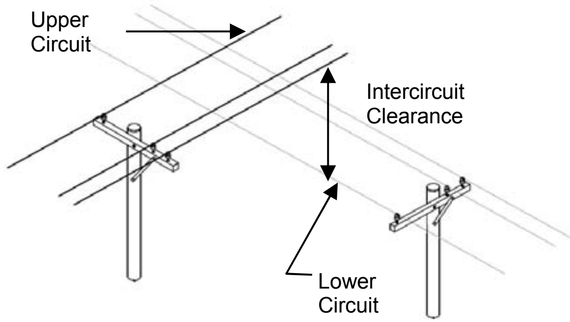


13.2.4 Unattached conductor crossings

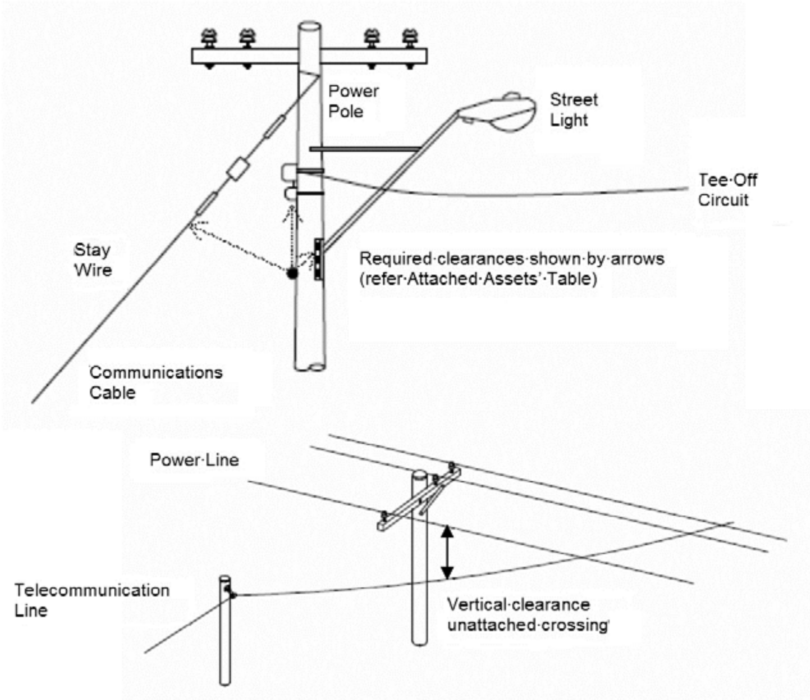
			Upper Circuit							
			66kV – 132kV bare	>33kV – 66kV bare	33kV bare or covered	11kV - 33kV insulated	11kV, 22kV, 12. 7kV SWER bare or covered	LV bare, covered or insulated	Other cables – conductive	Other cables – non-conductive
			m	m	m	m	m	m	m	m
Lower Circuit	66kV – 132kV bare	No wind	3. 0							
		Wind	1. 5							
	>33kV – 66kV bare	No wind	3. 0	2. 5						
		Wind	1. 5	0. 8						
	33kV bare or covered	No wind	3. 0	2. 5	2. 0					
		Wind	1. 5	0. 8	0. 5					
	11kV - 33kV insulated	No wind	3. 0	2. 5	2. 0	2. 0				
		Wind	1. 5	0. 8	0. 5	0. 4				
	11kV, 22kV, 12. 7kV SWER bare or covered	No wind	3. 0	2. 5	2. 0	2. 0	1. 5			
		Wind	1. 5	0. 8	0. 5	0. 4	0. 5			
	LV bare, covered or insulated	No wind	3. 0	2. 5	2. 0	2. 0	1. 5	1. 0		
		Wind	1. 5	0. 8	0. 5	0. 4	0. 5	0. 4		
	Other cables – conductive	No wind	3. 0	2. 5	2. 0	2. 0	1. 5	1. 0	0. 6	0. 4
		Wind	1. 5	0. 8	0. 5	0. 4	0. 5	0. 4	0. 4	0. 2
	Other cables – non-conductive	No wind	3. 0	2. 5	2. 0	2. 0	1. 5	1. 0	0. 6	0. 4
		Wind	1. 5	0. 8	0. 5	0. 4	0. 5	0. 4	0. 4	0. 2

Notes:

1. Wind condition is where the lower circuit is subject to blowout and swings upward.
2. The above clearances may need to be increased due to local factors or to meet safe approach distances required for construction, operation and maintenance.
3. The above clearances are based on the top circuit being at maximum conductor temperature and the bottom circuit at 15°C.
4. If conditions are such that it is likely that the lower circuit can flick up into the upper circuit, the vertical separation at the crossing point should be twice the sag of the lower circuit when the conductors or cables are at their maximum design temperature.



13.3 Telecommunications clearances



	Clearances from Conductors			
	Low Voltage (uninsulated)	Low Voltage (insulated, including services)	11kV, 22kV, 12. 7kV SWER, 33kV, 66kV	132kV
	m	m	m	m
Attached to pole	0. 8	0. 3	2. 0	2. 0
Unattached to pole	3. 0 (2. 1)	3. 0 (2. 1)	3. 0 (2. 1)	4. 0 (3. 0)

	Clearances from attached Assets (other than conductors)	
	Low Voltage (uninsulated)	Low Voltage (insulated)
	m	m
Earthed Metalwork	0. 45	-
LV Assets5	0. 75	0. 4
LV switching devices	1. 0	0. 5
Street light brackets, stay wires	0. 1	-

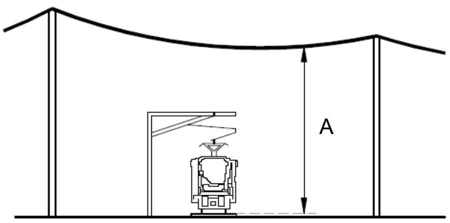
Notes:

1. The clearances shown in brackets are minimum clearances as listed in the Regulations, Codes and Agreements.
2. Telecommunication cables include broadband cable (cable TV), ADSS, telephone and pilot cables.
3. The clearances indicated in the table represent the separation between cables/conductors and not king bolt spacings.
4. Telecommunication cables are not normally attached to poles where the highest voltage exceeds 66kV.
5. 'LV assets' include attachments and cabling related to street lights, overhead services, LV underground cable terminations and LV bridging.
6. The minimum clearance above telephone lines shall be determined with the power line super-circuit at maximum design temperature and the telecommunication sub-circuit at 15°C.

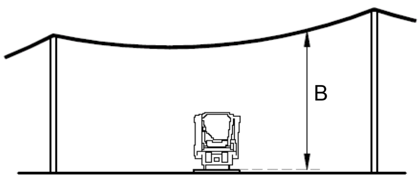
13.4 Railway crossings

Dimension	Application	LV Insulated or Bare	11kV, 22kV, 12. 7kV SWER, 33kV, 66kV	132kV
		m	m	m
A	Over electrified railway lines	12. 0 (11. 6)	12. 0 (11. 6)	12. 0 (11. 6)
B	Over non-electrified railway lines	8. 0 (7. 6)	10. 0 (8. 8)	12. 0 (10. 7)

Electrified Railway Crossings



Non-Electrified Railway Crossings

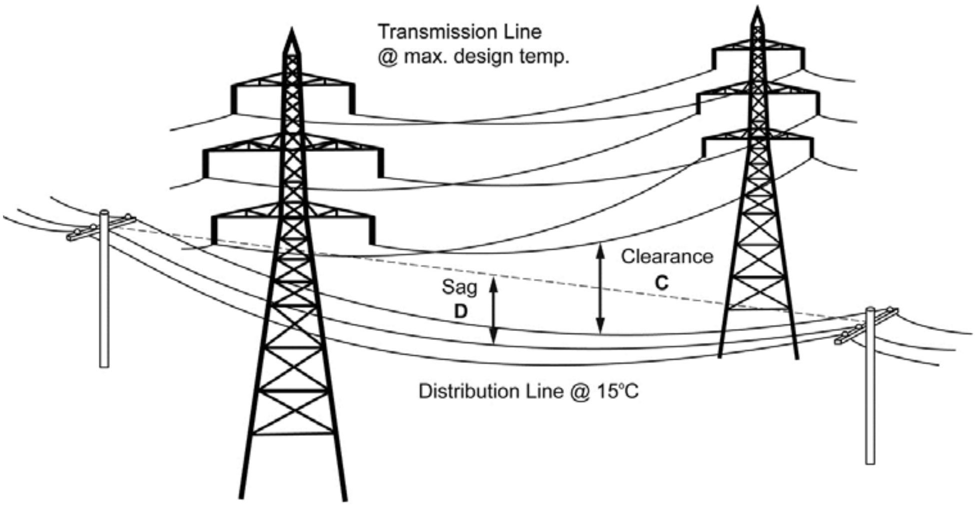


Notes:

1. The figures in brackets in the table are minimum clearances as listed in the Regulations, Codes or Agreements.
2. Railway crossings shall be designed in association with the Railways Infrastructure Corporation requirements.

13.5 Transmission undercrossings

The Designer shall consult with TransGrid or other asset owner, submitting a detailed plan of the line route in the vicinity of the crossing, showing positions of distribution and transmission structures, as well as a distribution line profile with conductors at 5ºC.



	Upper Circuit					
Lower Circuit			132kV	>132 – 275kV	>275 – 330kV	>330 – 500kV
			m	m	m	m
	Ausgrid Circuits and Cables - All voltages	No wind	2. 4	2. 8	3. 8	5. 2
		wind	1. 5	2. 8	2. 6	3. 6

Notes:

1. The table provides minimum requirements to prevent circuit to circuit flashover, under both normal and fault conditions, between aerial conductors or cables of different circuits that cross each other and are not attached to the same pole or support at the point of crossing.
2. Wind condition is where the lower circuit is subject to blowout and swings upward.
3. The clearances listed in the table may need to be increased due to local factors or to meet safe approach distances required for construction, operation and maintenance.
4. Minimum clearance of distribution conductors from Transgrid structures is 15m.
5. A sketch of Transmission undercrossings shall be submitted to Transgrid for approval. The sketch shall show plan and profile views of the proposed undercrossing and include details of poles, conductor heights and other relevant data.
6. If conditions are such that it is likely that the lower circuit can flick up into the higher circuit e. g. due to vegetation, the vertical separation (C) at the crossing point shall be:

   C = 2D

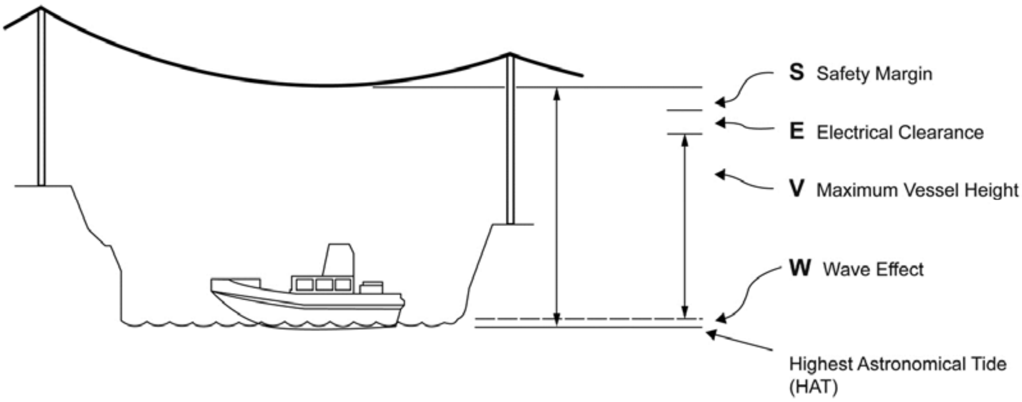
   where:

   C = Required intercircuit clearance with upper circuit at max. design temp.

   D = Conductor sag of the lower circuit at 15°C
7. Install terminations on undercrossing circuit either side of transmission line easement to permit easier undercrossing conductor temporary removal to permit Transmission Line reconductoring works.
8. Do not position Distribution or Subtransmission line support structures under Transgrid conductor span.
9. Consider HV Induction Hazard reduction in line design construction & maintenance.

13.6 Navigable waterway crossings

Clearances



Required Clearance *R* = *W* + *V* + *E* + *S*

Required Waterway Crossing Data		
Clearance Element	Data Source	Considerations
HAT + wave effects	NSW Maritime/ Dept of Lands	
Height of expected vessels	NSW Maritime/ Dept of Lands	
Electrical clearances	Ausgrid	As per Electrical Clearance table
Safety margin	Ausgrid	Based on risk assessment – min. 2200mm required

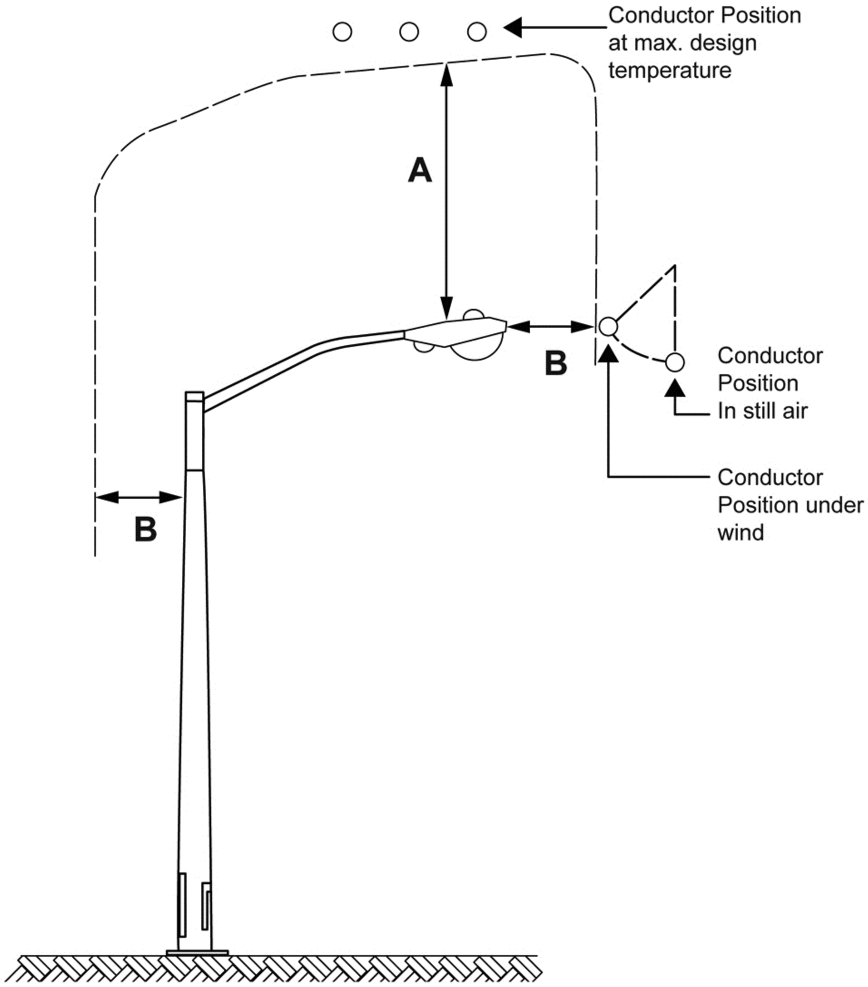
Electrical Clearances for Uninsulated Conductors, E	
Circuit Voltage (kV)	Clearance (mm)
≤ 33	300
66kV – 132kV	800
220	1300
275	2000
330	2600
400	3000
500	3600

Notes:

1. The ‘Crossing Controller’ is responsible for determining the final clearance. The Crossing Controller can be an Ausgrid person.
2. Waterway crossings over navigable waters are determined in association with the relevant statutory bodies or landowners, e. g. NSW Maritime or Department of Lands and other interested entities. The following may be required for overhead crossings:
   - Warning signs, signage lighting on both sides of the waterway
   - Coloured marker balls and/or coverings attached to conductors.
   - Waterway crossing signs are to be designed in accordance with TI 2000 -Overhead Mains Crossings of Other Services.
3. Any excavation or filling activities undertaken in association with the crossing must be approved by the responsible landowner.
4. The approval process is incorporated into the Crossings of NSW Navigable Waters: Electricity Industry Code.

13.7 Streetlight clearances

Dimension	Location	Low Voltage			11kV – 33kV			66kV – 132kV
		Insulated	Bare neutral	Bare Active	Insulated with earthed screen	Insulated without earthed screen	Bare or covered	Bare
		m	m	m	m	m	m	m
A	Vertically: above street light	0. 1	2. 7	2. 7	2. 7	2. 7	3. 7	4. 5
B	Horizontally: from any part of the street light	0. 1	0. 3	0. 6	0. 1	0. 6	1. 5	2. 5

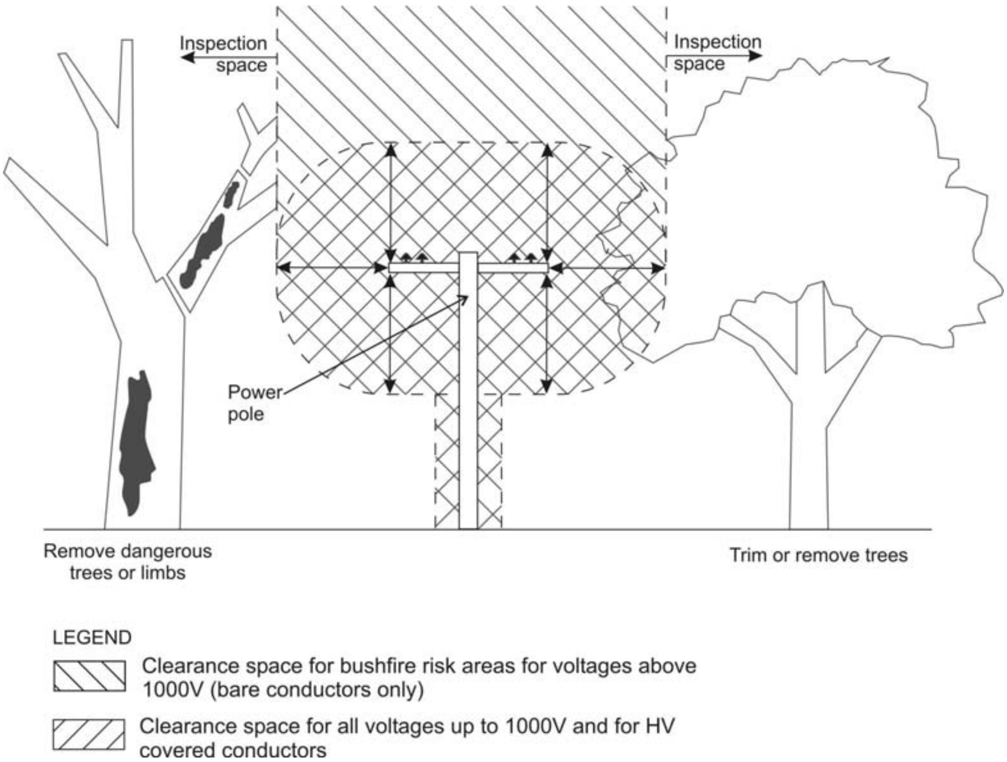


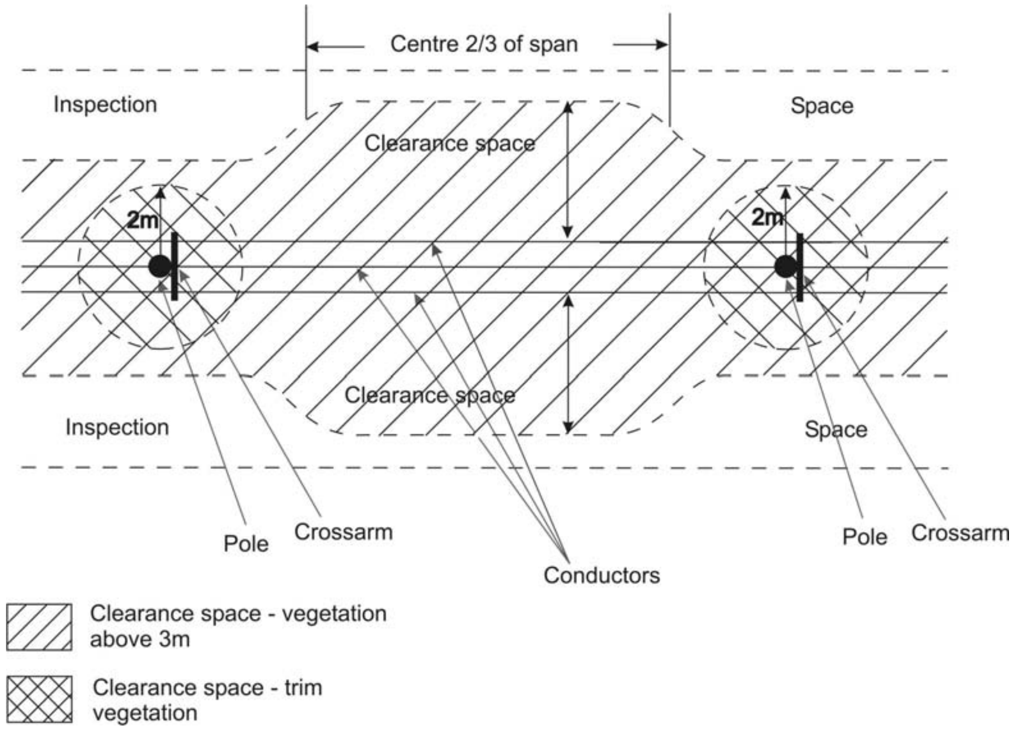
13.8 Vegetation clearance

Refer to NEG-OH21Vegetation Safety Clearances and ISSC3, Guideline for Managing Vegetation Near Power Lines

Distribution and Transmission Lines

Conductor Type and Voltage	Clearance at Pole to nearest Conductor		Clearance along middle 2/3 of span to nearest conductor in rest position	
	Urban	**Bushfire Risk Area**	**Urban**	**Bushfire Risk & Urban Spans > 100m**
	m	m	m	m
• LVABC • insulated service cables • pilot cables	0. 5	0. 5	0. 5	1. 0
HVABC	0. 5	0. 5	1. 0	1. 5
LV - bare	1. 0	1. 5	Horizontal – 1. 5 Vertical above – 1. 5 Vertical below – 1. 0	2. 5
11kV, 22kV bare	1. 5	2. 0	2. 5	3. 5
11kV, 22kV covered	1. 0	1. 0	2. 0	2. 5
33kV covered	1. 5	2. 0	2. 5	3. 5
>22kV – 66kV bare conductor	2. 0	2. 0	3. 0	4. 0
>66kV to 132kV bare conductor	3. 0	3. 0	4. 0	5. 0
Around poles and structures	2. 0			
Around stay wires	2. 0			





Notes:

1. Add 1.5m for spans between 200m and 400m and 2.0m for spans greater than 400m.
2. For vertical clearances, add 2m for spans between 200m and 400m, and 3m for spans greater than 400m. For horizontal clearances on spans greater than 200m, trim to 10m from the outer conductor, or to the limit of the easement where the easement width exceeds 10m from the outer conductor.

13.9 Engineering notes

Under development

14.0 EARTHING

14.1 Application guidelines

Refer to Network Standard NS116.

14.2 Coordination with telecommunications

Under Development.

14.3 Earthing points on CCT

Under Development.

15.0 SOFTWARE

15.1 Software overview

This section presents details of settings to be used for various overhead line design software packages known to Ausgrid.

It is critical that software be configured correctly in order to yield results in keeping with Ausgrid standards for limit state design as set out in this manual, particularly section 2 ‘Design Summary’. Use of a software package does not make one a line designer! These packages are merely tools and are no substitute for an understanding of line design principles.

The user should also ensure that the version of the software that they are using is suitable for implementing limit state design in accordance with Ausgrid standards. Also, data concerning conductors and poles should be checked against that provided in sections 4 and 6 respectively.

Electrical and Mechanical design software tools can have a safety risk impact for workers and public.

AS/NZS ISO/IEC 90003.2007 Software Engineering Guidelines for the application of AS/NZS ISO 9001-2000 to computer software, outlines the competence, awareness and training, infrastructure, work environment, and product realisation – validation, testing, control of development and development changes.

Other overhead line design software packages and/or design methodologies may be used subject to first demonstrating to Ausgrid that the software uses appropriate methods and data, yielding correct results, e. g. by comparison with hand calculations, other recognized software packages or the tables in this manual for a range of test cases.

In all cases, for every design submitted to Ausgrid, the designer shall:

- nominate the design software/methodology used
- provide evidence that they have undergone training and/or are competent in the use of the software/methodology *(by Dept of Fair Trading Assessment, Employer Grandfathering, Peer review, EE Oz RTO, or specific Software Supplier Training & Assessment)*
- warrant that they have applied the software/methodology appropriately
- Demonstrate this with copies of appropriate inputs and outputs, software progress reporting etc. and show how this was used to achieve the required limit state design outcome shown in the submitted design drawing.

Also, where appropriate, designers shall submit output files such as line profiles, survey data and route plans.

It should be noted that there is a measure of variation in results yielded by the different software packages presented in the following subsections. Underlying calculation methods should be in accordance with Reference 23 (or prior to its imminent publication to ENA C(b)1-2006), although it is recognized that some reputable packages are aligned more with standards used in other countries. Also, all packages include simplifying assumptions in their modelling of the line components and the various actions upon them and this will result in differences in results produced.

The designer, whether internal or an ASP3, is responsible for the design. The designer will make judgements according to the Network Standards and the appropriate Australian Standards and Guidelines. The requirements set down in Ausgrid’s Network Standards are a minimum. If the designer provides a more conservative (and therefore higher cost) design, then he should show reasonable justification.

The designer is also responsible for the proper function of any software used as a tool selected to achieve a design. A useful reference with respect to software maintenance is AS /NZS ISO IEC 90003. 2007.

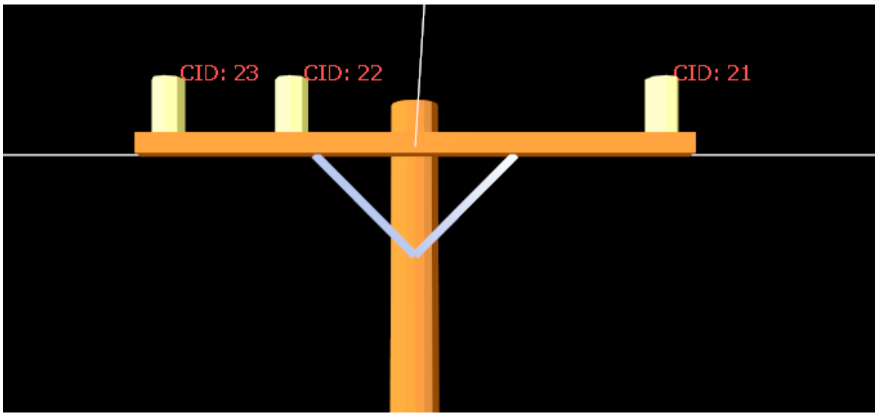
A design checker, who in some cases may be an Ausgrid officer responsible for the certification of a design, does not take responsibility for the design itself.

He may, as part of his role provide design information as part of a design brief, which would be applied in a designer's software package, but he is not responsible for the accuracy or integrity of this information.

A design checker, while ensuring that a design complies with Network Standards, may decide that a design may warrant alteration from an economic or safety viewpoint, however the designer remains responsible for deciding on and effecting any alteration.

Libraries for overhead design software usually constitute detail of the constructions and materials used in an overhead design.

Constructions (or frames) constitute the layout of cross arms, insulators and hardware on a pole, and their clearances.



The above frame is an 11kV 2-1 construction from the TL-Pro Library.

Detail of materials used by Ausgrid is provided in NS220. This data includes:

- Timber pole dimensions and strength grades
- Timber cross arm dimensions and strength grades
- Conductors
- Insulators

Design parameters such design wind pressures, and material strength reduction factors are listed in NS220. A designer is expected to demonstrate either with a statement or printout from software used that these parameters have been applied as a minimum in the design.

Calculation integrity - The accuracy, integrity and reliability of the overhead design package used remain the responsibility of the designer. This extends to the mathematical formulae and methodology applied to determine conductor sag and tension and pole or cross arm capacity.

Limit state and how to deal with it - Standards require that overhead designs are conducted using a limit state approach. If the software does not apply limit state then the designer should demonstrate how calculated results from the software are used to simulate a satisfactory result.

Structural analysis reports should demonstrate the degree of loading that is applied to key components of a structure. This usually extends to the pole, cross arm, conductor and insulators. The report below demonstrates the percentage loading on each component of the structure for two load cases:

- Sustained load case (no-wind, 5°C)
- Rural maximum wind load case (966Pa @ 15°C)

Component	Sustained Load	Rural Wind
Brace –Xarm – Flat - 40x5x690mm	0.86	1.10
Brace –Xarm – Flat - 40x5x690mm	0.89	0.80
Xarm – Wood – 100x100x2700mm+Brace – 2x690mm	7.16	10.36
Insul – 11/22kV – ALP-Ceramic	0.25	-88.31
Insul – 11/22kV – ALP-Ceramic	0.25	-88.15
Pole Top Bracket	0.25	12.62
Insul – 11/22kV – ALP-Ceramic	0.26	-75.16
14.0m08kN-TT	0.82	30.63

Accuracy of the profile - Once again, this is the responsibility of the designer and dependent on reliable survey data. Often 2-metre contour data from a data base is sufficient for a simple urban design. However, accurate survey instruments are usually required for designs.

Some software is limited to the use of two dimensional data which may be a problem if the line is along a steep slope or embankment.

15.2 TL-Pro settings

Produced by: TRIMBLE (formerly Pondera Engineers)
Website: www.trimble.com/energysolutions
Version below: 2. 0

The TL-Pro platform is currently testing under a 64-bit Windows 7 and Office 2010 operating environment.

TL-Pro in brief:

- Trimble TL-Pro allows Overhead Line designers to model multiple distribution and/or transmission line scenarios and manage design standards in its interactive design environment.
- It includes sag and tension calculations, finite element structural analysis, true 3D global optimization, and project estimates and material lists via its powerful material manager module.
- Accuracy, flexibility and user productivity is enhanced by a 3D visualization terrain model and can be applied in a variety of situations, including project reviews, marketing, siting
- TL-Pro has a wide range of digital survey data input options, and paper profile scanning option.
- TL-Pro does not perform pole foundation design.

TL-Pro Software Overhead Line Design Tool is used for:

- Managing terrain and survey data
- Line Design Optimization
- Use of multiple design scenarios
- How to easily evaluate wood, steel, or concrete pole alternatives
- Evaluate alternative alignments
- Advanced conductor sag/tension design and analysis
- Building and editing structures for your data libraries
- Design analysis
- Structure and Clearance analysis

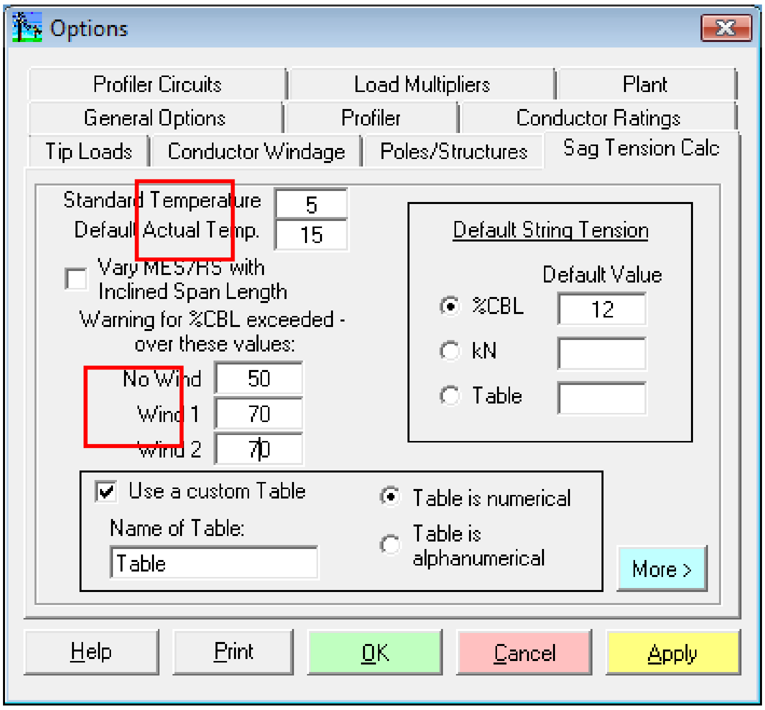
The TRIMBLE website access has several references, for example:

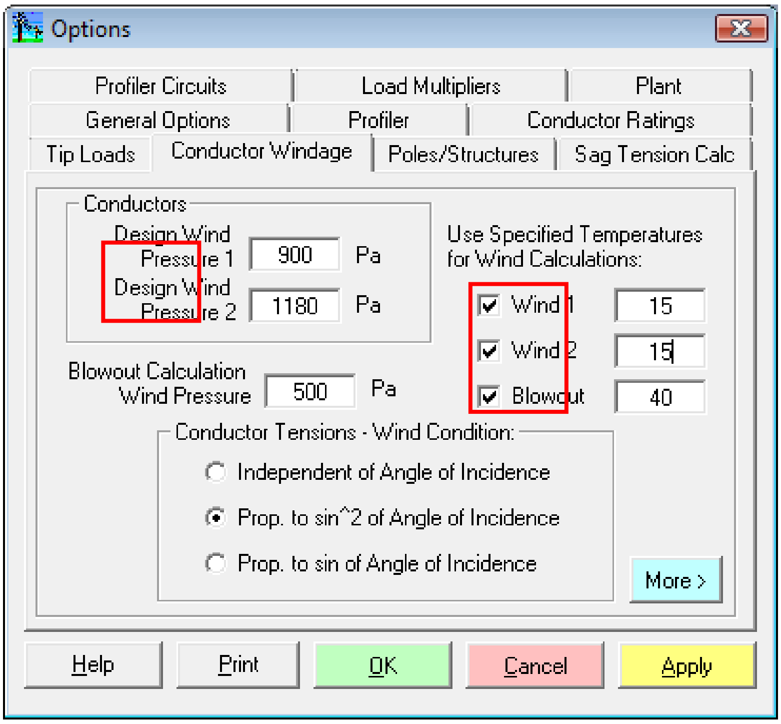
- a White Paper on Sag and Tension Calculations
- a Paper on Structural Analysis for Electric Power Transmission Structures
- TRIMBLE Insulator Swing Calculation

15.3 Poles 'n' wires settings

Produced by: PowerMation
Website: www.ipowermation.com
Version illustrated below: 5. 0

Standard settings for use of this software for Ausgrid distribution design are shown below. From time-to-time, these may need to be amended by users to suit particular circumstances.





Users may wish to set up the Structures Database to reflect the Ausgrid range of wood poles, as set out in Clause 9. 2. 1.

15.4 PLS-CADD settings

Produced by: Power Line Systems (Australian distributor: Dulhunty Power)
Website: www. powline.com/products/pls_cadd.html or www.dulhunty.com/index1.htm
Version illustrated below: Release 9. 0

User Feedback

PLS CADD (Standard Edition) is probably the most popularly used Finite Element Analysis design software for transmission line design, used for optimum support structure spotting, sags and tensions, analysis of loads on structures, and 3-D vegetation clearance analysis and vegetation clearances management

There is a PLS CADD Lite Edition too.

In Australia, the Dulhunty Group market PLS CADD and run periodic Training sessions in its use.

15.5 Live wire settings

Produced by: Rob Wilks Technology
Website: www.powerlinedesign.com.au
Version illustrated below: 3. 0

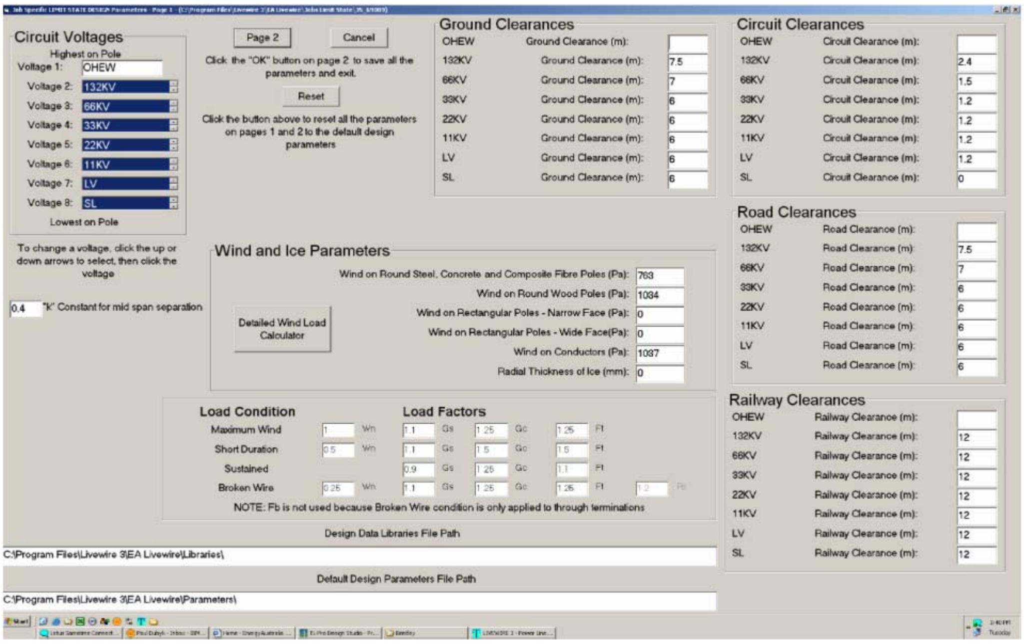
User Feedback Comment

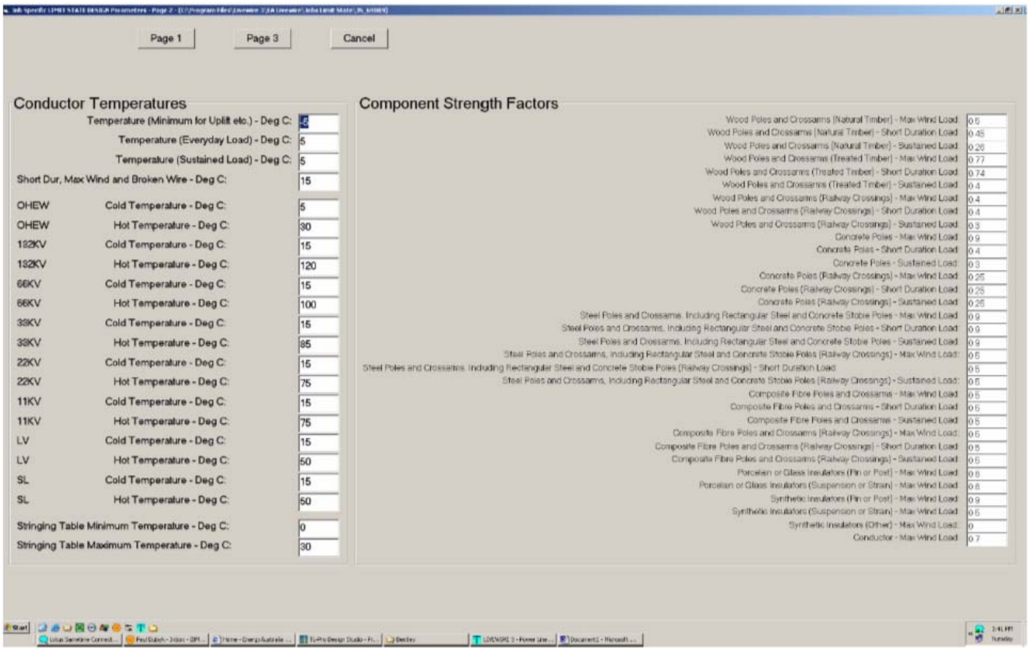
This is a traditional 2-D plot software design tool.

It has a range of options for digital survey data upload.

If the designer user's Live Wire Version 3. 0 Data Library is not common to both software users, then they can not open each other's design files.

Data Library for Ausgrid Network Materials is ideally standardised to permit Live Wire Version 3. 0 Files to be digitally transferred and opened at receiver end.




Page 1
Page 3
Cancel
Conductor Temperatures
Temperature (Minimum for Uplift etc.) - Deg C: -5
Temperature (Everyday Load) - Deg C: 5
Temperature (Sustained Load) - Deg C: 5
Short Dur, Max Wind and Broken Wire - Deg C: 15
OHEW Cold Temperature - Deg C: 5
OHEW Hot Temperature - Deg C: 80
132KV Cold Temperature - Deg C: 15
132KV Hot Temperature - Deg C: 120
66KV Cold Temperature - Deg C: 15
66KV Hot Temperature - Deg C: 100
33KV Cold Temperature - Deg C: 15
33KV Hot Temperature - Deg C: 85
22KV Cold Temperature - Deg C: 15
22KV Hot Temperature - Deg C: 75
11KV Cold Temperature - Deg C: 15
11KV Hot Temperature - Deg C: 75
LV Cold Temperature - Deg C: 15
LV Hot Temperature - Deg C: 50
SL Cold Temperature - Deg C: 15
SL Hot Temperature - Deg C: 50
Stringing Table Minimum Temperature - Deg C: 0
Stringing Table Maximum Temperature - Deg C: 30
Component Strength Factors
Wood Poles and Crossarms (Natural Timber) - Max Wind Load 0.5
Wood Poles and Crossarms (Natural Timber) - Short Duration Load 0.45
Wood Poles and Crossarms (Natural Timber) - Sustained Load 0.26
Wood Poles and Crossarms (Treated Timber) - Max Wind Load 0.77
Wood Poles and Crossarms (Treated Timber) - Short Duration Load 0.74
Wood Poles and Crossarms (Treated Timber) - Sustained Load 0.4
Wood Poles and Crossarms (Railway Crossings) - Max Wind Load 0.4
Wood Poles and Crossarms (Railway Crossings) - Short Duration Load 0.4
Wood Poles and Crossarms (Railway Crossings) - Sustained Load 0.3
Concrete Poles - Max Wind Load 0.9
Concrete Poles - Short Duration Load 0.4
Concrete Poles - Sustained Load 0.3
Concrete Poles (Railway Crossings) - Max Wind Load 0.25
Concrete Poles (Railway Crossings) - Short Duration Load 0.25
Concrete Poles (Railway Crossings) - Sustained Load 0.25
Steel Poles and Crossarms. Including Rectangular Steel and Concrete Stobie Poles - Max Wind Load 0.9
Steel Poles and Crossarms. Including Rectangular Steel and Concrete Stobie Poles - Short Duration Load 0.9
Steel Poles and Crossarms. Including Rectangular Steel and Concrete Stobie Poles - Sustained Load 0.9
Steel Poles and Crossarms, Including Rectangular Steel and Concrete Stobie Poles (Railway Crossings) - Max Wind Load: 0.5
Steel Poles and Crossarms. Including Rectangular Steel and Concrete Stobie Poles (Railway Crossings) - Short Duration Load 0.5
Steel Poles and Crossarms, Including Rectangular Steel and Concrete Stobie Poles (Railway Crossings) - Sustained Load: 0.5
Composite Fibre Poles and Crossarms - Max Wind Load 0.5
Composite Fibre Poles and Crossarms - Short Duration Load 0.5
Composite Fibre Poles and Crossarms - Sustained Load 0.5
Composite Fibre Poles and Crossarms (Railway Crossings) - Max Wind Load: 0.5
Composite Fibre Poles and Crossarms (Railway Crossings) - Short Duration Load 0.5
Composite Fibre Poles and Crossarms (Railway Crossings) - Sustained Load 0.5
Porcelain or Glass Insulators (Pin or Post) - Max Wind Load 0.8
Porcelain or Glass Insulators (Suspension or Strain) - Max Wind Load 0.8
Synthetic Insulators (Pin or Post) - Max Wind Load 0.9
Synthetic Insulators (Suspension or Strain) - Max Wind Load 0.5
Synthetic Insulators (Other) - Max Wind Load: 0
Conductor - Max Wind Load 0.7

15.6 *CATAN* settings

Produced by: CATAN Pty Ltd
Website: www.catanlines.com.au
Version illustrated below: 7. 3

Wind loads

Wind Pressures appropriate to Limit State Design are to be entered for the Conductor Wind Pressure and the Pole Wind Pressure. The easiest way to do this in CATAN is to add or modify the Design Wind Pressure section of the configuration file catan. cfg as shown below.

<DesignWindPressures>

'Region,Wind on Conductor (Pa),Wind On Pole (Pa)

Ausgrid,900,1300

<\DesignWindPressures>

The structure of this section is:

<DesignWindPressures> - Section Header

'Region,Wind on Conductor (Pa),Wind On Pole (Pa) - Comment line indicated by ‘ symbol at the start of the line. This line indicates the data required and the order of the data. The first parameter **Region** is the title displayed to the user, **Wind on Conductor** is the wind pressure value to use on the conductor in Pascals, and **Wind on Pole** is the wind pressure value to use on the pole.

<\DesignWindPressures> - This marks the end of the section. Note the \ character.

When a new job is started a form is presented the appropriate wind pressures can be selected. These values can be changed by the user within the program if required.

Limit state conductor tensions

The maximum tension in the conductor is specified as a percentage of the calculated breaking load. The values in the conductor library need to be checked and/ or modified to suit.

Design loads

The approach takes within CATAN is to parameterise the factors □, A, B, C, D, E and G in the generalised equation below into user definable values.

$$k*\square*R_s > A*W_n + B*G_s + C*G_c + D*F_t + E*Q_v + G*Q_L$$

where

k	Duration of Load Factor
ø	strength factor
Rs	Nominal strength of component
Wn	Wind Load on Pole, Crossarm, Components and Conductor
Gs	Vertical Dead Loads resulting from non-conductor loads
Gc	Vertical Dead Loads resulting from conductor loads
Ft	Load on structure from conductor tension for the appropriate wind load
Qv	Maintenance Loads in the vertical direction
QL	Maintenance Loads in the Horizontal direction

Within the program G_s is ignored as there is no data stored within CATAN as these loads would normally be small. See C(b)1-2006 Page 27 worked example.

CATAN settings

To perform these calculations the following needs to be added to the file CATAN. ini (as with the catan. cfg file any line starting with the ‘ character signifies a comment)

'this is for parameterised calculations eg new Ausgrid Design Criteria

' generalised formulae is (G & Ql refer to dynamic loads as per Ausgrid Standardard NS126)

'k*□*R > A*Wn + B*Gs + C*Gc + D*Ft + E*Qv + G*Ql

'Loadcase Name, k,Theta, Temp, Wind Conductor, Wind Pole, A, B, C, D, E, Qv, G, Ql

LoadCondition= Maximum Wind Load, 1. 00, 0. 45, 15, 900, 1300, 1, 0, 1. 25, 1. 5, 0, 0, 0, 0

LoadCondition= Sustained Load, 0. 57, 0. 45, 5, 0, 0, 0, 0, 1. 25, 1. 5, 0, 0, 0, 0

LoadCondition= Maintenance Load, 0. 97, 0. 45, 15, 100, 144, 1, 0, 1. 50, 1. 5, 2, 1400, 0, 0

LoadCondition= Construction Load, 0. 97, 0. 80, 15, 60, 87, 1, 0, 1. 50, 1. 5, 2, 1400, 2, 1400

These parameters are modified as required. Note that the wind values are in Pascals.

The pole capacity in these calculations is based on the Allowable Timber Bending Stress. This is also specified by an entry in the catan. ini file as shown below.

' this is the timber limit state bending stress for Ausgrid Limit State Calculations

' value is in MPa. From AS 1720. 1-1997 Table 2. 4 Page 22 Structural Design Properties for F-Grades

TimberBendingStress=85

Interactive design

Within the Configure Option in Interactive Design the user can now turn on the results of the load cases. If the load case fails for a pole, then it is displayed in red on the screen.

CATAN settings

The Ausgrid Pole Capacity Report details the elements of the Load Condition as shown below.

Pole No.	Length (m)	Nominal Strength (kN)	Setting Depth (m)	Loadcase	Degraded Pole TipStrength (kN)	Calculated Tip Load (kN)	Wn Pole (kNm)	Wn Conductor (kNm)	Gs (kNm)	Gc (kNm)	Ft (kNm)	Qv (kNm)	Ql (kNm)
1	12. 5	12	2. 15	Maximum Wind Load	10. 1	33. 18	17. 72	7. 93	0	-0. 05	211. 91	0	0
1	12. 5	12	2. 15	Sustained Load	5	13. 04	0	0	0	0. 14	89. 83	0	0
1	12. 5	12	2. 15	Maintenance Load	8. 52	13. 11	1. 96	0. 88	0	0. 15	82. 81	4. 2	0
1	12. 5	12	2. 15	Construction Load	15. 33	15. 35	1. 19	0. 53	0	0. 16	80. 55	4. 2	13. 86
2	12. 5	12	2. 3	Maximum Wind Load	10. 09	4. 32	17. 17	24. 61	0	0	1. 54	0	0
2	12. 5	12	2. 3	Sustained Load	5	0. 09	0	0	0	0	0. 62	0	0
2	12. 5	12	2. 3	Maintenance Load	8. 51	0. 87	1. 9	2. 73	0	0	0. 58	1. 68	0
2	12. 5	12	2. 3	Construction Load	15. 31	3. 58	1. 15	1. 64	0	0	0. 56	1. 68	14. 76

The Ausgrid Conductor Capacity Report checks that the conductor tension for the Maximum Wind Load Case does not exceed the capacity as shown in the example in C(b)1 – 2006 Page 26. An example is shown below.

Limit State Conductor Capacity										
Report for Conductor :4x95 LVABC 4x95mm2 LV ABC at 7. 0 %CBL										
Pole	Pole	Chainage (m)	Span (m)	MES (m)	Nominal Breaking Load	Strength Factor	Maximum Limit State Tension (kN)	Limit State Tension (kN) (Ft)	1. 5* Ft	Result
1	2	20	20							
2	3	60	40							
3	4	115	55							
4	5	135	20	42. 7	53. 2	0. 4	21. 28	9. 238	13. 858	21. 280 > 13. 858
Report for Conductor :Pluto 19/3. 75 AAC PLUTO at 5. 0 %CBL										
Pole	Pole	Chainage (m)	Span (m)	MES (m)	Nominal Breaking Load	Strength Factor	Maximum Limit State Tension (kN)	Limit State Tension (kN) (Ft)	1. 5* Ft	Result
1	2	20	20							
2	3	60	40							
3	4	115	55							
4	5	135	20	42. 7	32. 3	0. 7	22. 61	4. 522	6. 783	22. 610 > 6. 783

16.0 POLICY AND PRACTICE

16.1 Developing standard interpretations/clarifications of accepted design practice

ES and NS publications define outcomes required for Ausgrid Overhead Line Designs.

The intent of this section is to provide opportunity to develop standard interpretations in Q&A format, to cater for standardising interpretations of the Design Manual, ES and NS publications as and when innovative but not optimal permutations or interpretations arise in practice.

In general good workmanship and practice, if left too open ended for designer design flexibility, can lead to unacceptable tight tolerances for economy, that cause unnecessary line reliability issues in service.

Comparison is made to AS 3000 Wiring Rules and its companion documents to facilitate prompt global circulated standardised Interpretation for in customer wiring design and construction.

An example for this Design Manual wrt "Policy" update, arose with other designers' criticism in reporting of leaning 11kV pin insulators on timber crossarm in D&C scenarios involving modest in line angles on newly installed intermediate pole crossarms. Although economical, the loadings required a borderline call to use in line termination dressings.

This was clarified by published decision to not permit in line pin crossarms being used on angles. The next time update periodically of Network Standards include such clarifications.

17.0 SUBJECT INDEX

18.0 RECORDKEEPING

The table below identifies the types of records relating to the process, their storage location and retention period.

Table 1 – Recordkeeping

Type of Record	Storage Location	Retention Period*
Approved copy of the network standard	BMS Network sub process Standard – Company	Unlimited
Draft Copies of the network standard during amendment/creation	TRIM Work Folder for Network Standards (Trim ref. 2014/21250/140)	Unlimited
Working documents (emails, memos, impact assessment reports, etc.)	TRIM Work Folder for Network Standards (Trim ref. 2014/21250/140)	Unlimited

* The following retention periods are subject to change eg if the records are required for legal matters or legislative changes. Before disposal, retention periods should be checked and authorised by the Records Manager.

19.0 AUTHORITIES AND RESPONSIBILITIES

For this network standard the authorities and responsibilities of Ausgrid employees and managers in relation to content, management and document control of this network standard can be obtained from the Company Procedure (Network) – Production/Review of Network Standards. The responsibilities of persons for the design or construction work detailed in this network standard are identified throughout this standard in the context of the requirements to which they apply.

20.0 DOCUMENT CONTROL

Content Coordinator : Transmission and Distribution Mains Engineering Manager

Distribution Coordinator : Engineering Information and Services Manager

Annexure A – Sample Compliance Checklist

Due to the generic nature of this manual and its application to both ASP and internal work a sample compliance checksheet has not been prepared.